UNIVERSITI TEKNIKAL MALAYSIA MELAKA

THE ASSESSMENT OF SCHEDULING FOR PREVENTIVE MAINTENANCE CONSIDERING CULTURAL VALUE

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DEDICATION

This thesis is dedicated to my parents, my family, my supervisor and to everyone whose encouragement and constant prayers have been the driving force behind my academic journey.

ABSTRACT

In the field of maintenance management, the efficiency of scheduling preventative maintenance is of utmost importance in guaranteeing the optimal operation and lifespan of industrial systems. This study examines the evaluation of scheduling for preventive maintenance, taking into account cultural values based on Hofstede's framework. It recognises the significant influence of cultural values on decision-making procedures. With the growing presence of organisations in varied cultural environments, it is crucial to comprehend the intricate relationship between cultural values, as defined by Hofstede's cultural dimensions, and the timing of preventive maintenance. Initially, a thorough analysis of the available literature was carried out to identify cultural factors that were relevant to the planning of maintenance activities. Following that, a survey was conducted to collect data regarding the cultural values and preferences of maintenance personnel and stakeholders. The study utilised factor analysis and regression analysis to investigate the associations between cultural values and scheduling outcomes. In addition, qualitative interviews and focus group discussions were conducted to provide a deeper understanding of the processes that influence the effect of cultural values on scheduling decisions. The qualitative insights provided crucial context for evaluating the quantitative findings. Other than that, This study utilises smartPLS and PLS-SEM to investigate the assessment of preventive maintenance scheduling. The aim of this study was to improve understanding of the cultural factors that influence the scheduling of preventive maintenance. The research aims to achieve three main objectives. Firstly, it aims to identify the criteria that influence preventive maintenance scheduling by conducting a comprehensive literature review. Secondly, it aims to determine the significant relationship between cultural values and the assessment of scheduling preventive maintenance in Malaysia. Lastly, it aims to qualitatively evaluate the broader relationship between cultural values and preventive maintenance scheduling through interviews and focus group discussions. The aims are to give in-depth understanding, guide industry practices, and encourage cultural awareness in decision-making processes, ultimately improving the scheduling of preventive maintenance in culturally varied environments.

ABSTRAK

Dalam bidang pengurusan penyelenggaraan, kecekapan penjadualan penyelenggaraan pencegahan adalah amat penting dalam menjamin operasi optimum dan jangka hayat sistem perindustrian. Kajian ini mengkaji penilaian penjadualan untuk penyelenggaraan pencegahan, dengan mengambil kira nilai budaya berdasarkan rangka kerja Hofstede. Ia mengiktiraf pengaruh penting nilai budaya terhadap prosedur membuat keputusan. Dengan kehadiran organisasi yang semakin meningkat dalam persekitaran budaya yang pelbagai, adalah penting untuk memahami hubungan yang rumit antara nilai budaya, seperti yang ditakrifkan oleh dimensi budaya Hofstede, dan masa penyelenggaraan pencegahan. Pada mulanya, analisis menyeluruh terhadap literatur yang ada telah dijalankan untuk mengenal pasti faktor budaya yang relevan dengan perancangan aktiviti penyelenggaraan. Susulan itu, tinjauan telah dijalankan untuk mengumpul data berkaitan nilai budaya dan keutamaan kakitangan penyelenggaraan dan pihak berkepentingan. Kajian ini menggunakan analisis faktor dan analisis regresi untuk menyiasat perkaitan antara nilai budaya dan hasil penjadualan. Selain itu, temu bual kualitatif dan perbincangan kumpulan fokus telah dijalankan untuk memberikan pemahaman yang lebih mendalam tentang proses yang mempengaruhi kesan nilai budaya terhadap keputusan penjadualan. Wawasan kualitatif menyediakan konteks penting untuk menilai penemuan kuantitatif. Selain itu, Kajian ini menggunakan smartPLS dan PLS-SEM untuk menyiasat penilaian penjadualan penyelenggaraan pencegahan. Matlamat kajian ini adalah untuk meningkatkan pemahaman tentang faktor budaya yang mempengaruhi penjadualan penyelenggaraan pencegahan. Kajian ini bertujuan untuk mencapai tiga objektif utama. Pertama, ia bertujuan untuk mengenal pasti kriteria yang mempengaruhi penjadualan penyelenggaraan pencegahan dengan menjalankan kajian literatur yang komprehensif. Kedua, ia bertujuan untuk menentukan hubungan yang signifikan antara nilai budaya dan penilaian penjadualan penyelenggaraan pencegahan di Malaysia. Akhir sekali, ia bertujuan untuk menilai secara kualitatif hubungan yang lebih luas antara nilai budaya dan penjadualan penyelenggaraan pencegahan melalui temu bual dan perbincangan kumpulan fokus. Matlamatnya adalah untuk memberi pemahaman yang mendalam, membimbing amalan industri, dan menggalakkan kesedaran budaya dalam proses membuat keputusan, akhirnya menambah baik penjadualan penyelenggaraan pencegahan dalam persekitaran yang pelbagai budaya.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS AND ABBREVIATIONS

PLS-SEM	-	Partial least square structural eaquation modelling
CR	-	Consistensy ratio
AVE	-	Average varience extracted
HTMT	-	Heterotrait-monotrait ratio
VIF	-	Variance inflation factor
Q2	-	Predictive relevance to predict model accuracy
q^2	-	A measure to assess the relative predictive relevance of a predictor construct on an endogenous construct
HOC	-	Higher-order component
LOC	-	Lower-order component
HCM	-	High-order component model
PLS	-	Partial Least Squares
SEM	-	Structural equation model

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

Preventive maintenance is a crucial aspect of assuring the proper operation of industrial equipment and machinery. By proactively scheduling inspections and repairs, companies can reduce the risk of unanticipated failures, minimize downtime, and maximize operational efficiency. An appropriate maintenance strategy is crucial for enhancing system reliability and profitability, as it impacts the performance of the industrial system in terms of availability, downtime, productivity, cost of production, and life cycle cost (Houda et al., 2019). A machine failure at any moment and evaluates numerous preventive maintenance levels with different prices, timeframes, and hazard rate reductions (Ali et al, 2017). However, the effectiveness of preventive maintenance extends beyond technical considerations, as deeply ingrained cultural values can considerably impact the scheduling and execution of maintenance activities. This thesis seeks to investigate the evaluation of preventive maintenance scheduling relation to cultural values.

The evaluation of preventive maintenance scheduling from a cultural value perspective necessitates an integrated approach. Through the integration of maintenance engineering, organisational behaviour, and cultural studies, this study aims to shed light on how cultural values influence maintenance practices. Through a review of existing literature, case studies, and data analysis, the purpose of this study is to identify key cultural factors that influence preventive maintenance scheduling decisions and to propose strategies for

aligning maintenance schedules with cultural values. The ultimate objective is to enable organisations to improve maintenance efficiency, increase employee satisfaction, and cultivate a harmonious, culturally sensitive work environment.

This thesis concentrates on the evaluation of preventive maintenance scheduling in relation to cultural values. Culture refers to the mental programming of the human mind, influencing patterns of thinking and shaping society's institutions. Differences in values among countries are often larger than in individual values, but country scores are generalizations (Hofstede, 2003). By acknowledging and incorporating cultural factors into maintenance strategies, organisations can optimise their maintenance scheduling practises, foster cultural sensitivity, and achieve operational excellence in culturally diverse workplaces. This study seeks to bridge the divide between technical maintenance practises and cultural considerations by providing organisations with recommendations for improving maintenance outcomes in diverse cultural contexts.

1.2 Problem Statement

The need to determine appropriate scheduling for preventive maintenance presents a significant challenge to industries, especially when cultural values are taken into account. Preventive maintenance is essential because it assists in identifying and resolving potential issues before they escalate into significant issues (Gargari et al., 2021). The application of preventive maintenance scheduling can increase the equipment's efficiency by ensuring that maintenance tasks are performed at regular intervals prior to any significant failure. This helps to identify and resolve potential issues before they become critical, decreasing the likelihood of unscheduled equipment outage and increasing the equipment's overall

reliability (Ebrahimi et al., 2018). Therefore, the absence of a schedule for preventive maintenance can result in increased costs due to unpredictable breakdowns. Although preventive maintenance is essential for ensuring operational efficiency and minimising disruption, the impact of cultural values on maintenance scheduling has not been sufficiently investigated. As organisations operate in diverse cultural contexts, the cultural norms, beliefs, and attitudes common to these contexts can have a substantial impact on the maintenance decision-making process. This lack of knowledge regarding the interaction between cultural values and preventive maintenance scheduling hinders the ability of industries to optimise their maintenance practises and adapt them to their particular cultural contexts. Therefore, it is important to assess the scheduling of preventive maintenance with cultural values in mind in order to improve maintenance outcomes and cultivate a culturally sensitive work environment.

1.3 Research Objective

The main aim of this research is assessing scheduling for preventive maintenance considering cultural values. Specifically, the objectives are as follows:

a) To identify the criteria of scheduling preventive maintenance in literature.

b) To determine the significant relationship between cultural values and the assessment of scheduling preventive maintenance in Malaysia.

c) To evaluate the relationship between cultural values and scheduling preventive maintenance in Malaysia.

1.4 Scope of Research

The scope of this research focuses on assessing the effectiveness of scheduling systems for preventive maintenance in two separate manufacturing organisations, taking into account the impact of cultural values on these activities. The study seeks to utilise Google Form survey to gather data from employees and decision-makers in organisations, with the goal of gaining a thorough understanding of the existing preventive maintenance schedules and the influence of cultural values on decision-making processes. Identifying the influences of cultural value in scheduling for preventive maintenance by using the six Hofstede cultural dimension.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A crucial aspect of maintenance management in organization with diverse cultural contexts is the assessment of scheduling for preventive maintenance considering cultural value. Preventive maintenance is important because it helps to prevent equipment failure and downtime, which can be costly for businesses. This review seeks to provide a comprehensive comprehension of how cultural values affect maintenance scheduling decisions by examining the concept of preventive maintenance, the role of culture in decision-making, and the integration of cultural values into maintenance practices. This literature review will contribute to the formulation of recommendations for organizations to optimize their preventive maintenance practices in consideration of cultural values based on its findings.

Preventive maintenance is an important maintenance strategy to prevent failures and extend Mean Time Between Failures (MTBF), ensuring asset protection and proper functioning (Claudia et al., 2013). Moreover, it helps to identify and fix potential issues before they become major problems that can help to reduce downtime, increase the lifespan of equipment, and improve the overall efficiency of the system (Milad et al., 2021). The concept of preventive maintenance, where components are replaced or repaired before wearing down, based on a schedule established with periods of exchange or repairs recommended by manufacturers of components and machines (André et al., 2018). The collection mode of scheduling for preventive maintenance is illustrated in Figure 2.1 below.

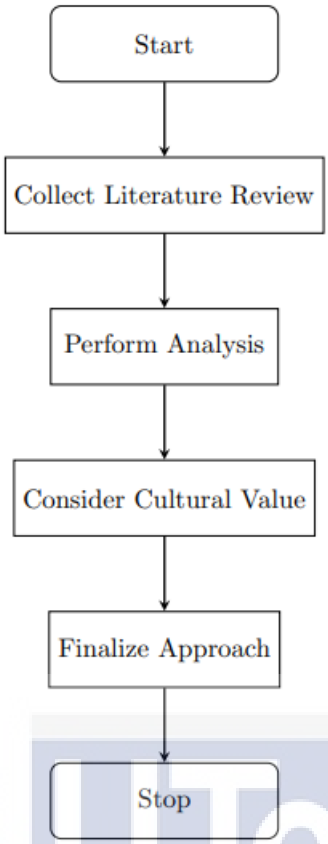

Figure 2.1: Literature Reveiw Flow for Scheduling Preventive Maintenance Considering Cultural Value

2.2 Scheduling for Preventive Maintenance Tools, Techniques and Methodologies

Preventive maintenance scheduling contains the use of various tools, techniques, and approaches to plan and organize routine maintenance work in order to prevent equipment failures and extend asset lifespan. Computerised maintenance management systems (CMMS) or enterprise asset management (EAM) software, for example, provide a centralised platform for scheduling and tracking maintenance activities. Reliability-centered maintenance (RCM) assists in the prioritisation of essential assets and the development of maintenance strategies based on failure modes. state-based maintenance (CBM) uses real-time monitoring and inspection to schedule maintenance based on the state of the equipment. TBM scheduled tasks at regular intervals, whereas planned maintenance (PM) optimisation

refines plans based on past data. Failure modes and effects analysis (FMEA) evaluates risks, whereas spare parts management ensures that critical components are available. Resource planning, statistical analysis, and continuous improvement also play important roles in optimizing preventive maintenance schedules. Table 2.1 show summary of the varied research contributions.

Table 2.1: Summary of the varied research contributions

Preventive Maintenance tools/ techniques/ methodology	**References**
Asset Management Systems	(Assaad & El-adaway, 2020; Candón et al., 2019; Y. Chen & Chen, 2022; Hernández-Chover et al., 2020; Konstantakos et al., 2019; Kumar, 2019; Love & Matthews, 2019; Maletič et al., 2022; Peraka & Biligiri, 2020; Trappey et al., 2015, 2015)
Reliability-Centered Maintenance (RCM)	(Azid et al., 2019; Geisbush & Ariaratnam, 2022; Patil et al., 2022; Sajaradj et al., 2019; Siddiqui & Ben-Daya, 2009; Sifonte & Reyes-Picknell, 2017)
Condition-Based Maintenance (CBM)	(Artina et al., 2020; Ayo-Imoru & Cilliers, 2018; Bousdekis et al., 2018; Y. Chen & Chen, 2022; Chuang et al., 2020; de Jonge et al., 2017, 2017; Hwang et al., 2018; L. Li et al., 2021; Zhong et al., 2019)
Time-Based Maintenance (TBM)	(Bousdekis et al., 2018; de Jonge et al., 2017; Konstantakos et al., 2019; Love & Matthews, 2019; Maletič et al., 2022; Sajaradj et al., 2019)
Planned Maintenance (PM) Optimization	(Arani et al., 2020; Basciftci et al., 2018; Farahani & Tohidi, 2021; Fontecha et al., 2020; Liu et al., 2018; Mena et al., 2021; Schouten et al., 2022; Shafiee & Sørensen, 2019; Z. Yang et al., 2020; Zheng et al., 2020)
Failure Modes and Effects Analysis (FMEA)	(Arani et al., 2020; Basciftci et al., 2018; Bhattacharjee et al., 2020; Farahani & Tohidi, 2021; Hassan et al., 2019; Huang et al., 2020; J. Li & Chignell, 2022; Liu et al., 2018; Sader et al., 2020; Schouten et al., 2022; Shafiee & Sørensen, 2019; Sotoodeh, 2020; Subriadi & Najwa, 2020; von Ahsen et al.,

	2022)
Spare Parts Management	(Basciftci et al., 2018; Chaudhuri et al., 2021, 2021; Liu et al., 2018; Subriadi & Najwa, 2020; von Ahsen et al., 2022; Zhang et al., 2021; Zhu et al., 2020)
Resource Planning	(Borangiu et al., 2019; Dev et al., 2020; Langenwalter, 2020; Mena et al., 2021; Ozkan-Ozen et al., 2020; Shafiee & Sørensen, 2019; Xiang et al., 2021)
Statistical Analysis	(Cai et al., 2019; Cakir et al., 2021, 2021; Carvalho et al., 2019; Collins & Preston, 2022; Cruz & Haugan, 2019; *IEEE Xplore - Page Not Found*, n.d.; Skelton et al., 2019; Wakiru et al., 2019; Wang et al., 2020)
Continuous Improvement	(Abbas & Shafiee, 2020, 2020; Coit & Zio, 2019; Fausing Olesen & Shaker, 2020; Jasiulewicz - Kaczmarek & Gola, 2019; Khalfallah & Lakhal, 2020; Pinto et al., 2019; L. Yang et al., 2021; Yuyang & Юйянг, 2023)

2.2.1 Asset Management System

An asset management system (AMS) is a framework for managing a company's physical assets while reducing breakdowns and poor quality (Silva & Souza, 2020). The asset management system is essential for the effective scheduling of preventive maintenance tasks. By proactively identifying and addressing maintenance requirements, this system optimizes resource allocation and minimizes disruption by utilizing advanced scheduling capabilities. By integrating historical data, condition monitoring, and predictive analytics, the system accurately predicts maintenance requirements, allowing organizations to plan and execute preventive maintenance activities in a timely manner. By automating the scheduling process, it ensures that equipment, machinery, and other assets receive routine maintenance, thereby minimizing the risk of unscheduled failures and maximizing their operational

lifecycle. The asset management system for scheduling preventive maintenance ultimately facilitates maintenance operations, improves equipment reliability, and contributes to increased productivity and cost savings.

2.2.2 Reliability-Centered Maintenance (RCM)

Reliability-Centered Maintenance (RCM) is a systematic approach that optimises maintenance costs while maximising the reliability and performance of assets. It is a thorough method for identifying and prioritising maintenance tasks based on their potential impact on system reliability, safety, and operational objectives. RCM entails a comprehensive analysis of asset functions, failure modes, and consequences, allowing businesses to develop maintenance strategies that are specifically tailored. RCM aids in determining the most appropriate maintenance strategy, whether it be preventive, predictive, or corrective, by assessing the criticality of various components and systems. This strategy improves equipment dependability by targeting maintenance efforts where they are required most, resulting in increased utilisation, enhanced safety, and decreased overall maintenance costs. RCM is a proactive, data-driven maintenance strategy that promotes effective resource allocation and assists organisations in attaining optimal asset performance and longevity. The RCM approach aids in determining which maintenance tasks must be carried out to keep the asset performing as intended (Alrifaey et al., 2020). It aids in scheduling and maintenance policy optimization, which can result in cost savings and improved productivity.

2.2.3 Condition-Based Maintenance (CBM)

Condition-Based Maintenance (CBM) is a maintenance strategy that determines maintenance requirements based on real-time monitoring and analysis of asset condition. The purpose of condition-based maintenance (CBM) is to carry out maintenance tasks according to how well the system is functioning. CBM uses monitoring, diagnostics, and prognostics to assess the system's health and spot possible problems before they have serious consequences (Ayo-Imoru & Cilliers, 2018). Utilising sophisticated sensors, data analytics, and predictive modelling techniques to evaluate the performance and health of apparatus and systems. By continuously monitoring parameters such as vibration, temperature, pressure, and other relevant indicators, Condition-Based Maintenance (CBM) enables maintenance activities to be scheduled based on the actual condition of the assets rather than at predetermined time intervals. This method permits organisations to detect early indications of deterioration or imminent failure, thereby facilitating timely and targeted maintenance interventions. CBM reduces the risk of unanticipated failures, optimises the allocation of maintenance resources, and extends the operational life of assets. CBM improves asset reliability, reduces maintenance costs, and enhances overall operational efficiency by leveraging technology and data-driven insights.

2.2.4 Time-Based Maintenance (TBM)

Time-based maintenance (TBM) is a maintenance approach in which maintenance tasks are carried out on a marine structure in accordance with a predetermined timetable or time interval, independent of the structure's actual state (Zou et al., 2019). Although this method is simple to apply, it might not be cost-effective because it might result in omitting

maintenance tasks or performing them unnecessarily, which could cause failures. It entails performing inspections, replacements, and restorations at fixed intervals, independent of the asset's condition. TBM is frequently utilized when historical data and experience indicate that certain components or systems require maintenance after a specific time period to ensure their continued performance and dependability. While TBM provides a straightforward and simple approach to maintenance planning, it may result in superfluous maintenance if assets are still in excellent condition or insufficient maintenance if problems arise prior to the scheduled interval. Nevertheless, TBM is still widely used for assets with known failure patterns and when cost-effective maintenance plans can be developed based on historical data. Effective implementation of TBM necessitates accurate recordkeeping, adherence to maintenance schedules, and periodic evaluations to ensure that the maintenance intervals remain optimal for asset reliability and performance.

2.2.5 Planned Maintenance (PM) Optimization

Planned Maintenance (PM) Optimization is a methodical strategy for enhancing the efficacy and efficiency of planned maintenance activities. It entails analysing and evaluating maintenance plans and duties in order to maximise resource utilisation, minimise disruption, and reduce costs. Asset criticality, failure modes, maintenance frequencies, and resource availability are taken into account by PM Optimisation. By conducting a comprehensive analysis of these factors, organisations can identify opportunities to streamline maintenance schedules, prioritise duties based on risk and impact, and optimise the allocation of labour, materials, and equipment. This strategy ensures that maintenance efforts are concentrated on the most important components and systems, maximising the value of each maintenance action. Planned maintenance is crucial because it reduces downtime needed for equipment

repair or replacement and helps to prevent equipment breakdowns (Noor et al., 2018). Not only does PM Optimisation improve asset reliability and performance, but it also contributes to enhanced operational efficiency, decreased costs, and increased overall productivity.

2.2.6 Failure Modes and Effects Analysis (FMEA)

Failure Modes and Effects Analysis (FMEA) is a systematic method for identifying potential failure modes, evaluating their consequences, and prioritising preventive maintenance activities accordingly. FMEA, or failure modes and effects analysis, is a technique for locating and assessing probable flaws in a system, item, or procedure (Sagnak et al., 2020). It entails examining the potential causes, consequences, and chances of a failure as well as its likely occurrence. By quantifying these factors, organisations can prioritise preventive maintenance duties according to the failure mechanisms with the highest risk. FMEA provides insight into the criticality of various components, allowing maintenance teams to effectively allocate resources and implement targeted maintenance strategies. This strategy guarantees that preventive maintenance efforts are concentrated on mitigating the most significant risks, minimising downtime, enhancing asset reliability, and optimising maintenance scheduling for maximum efficiency.

2.2.7 Spare Parts Management

Spare Parts Management plays an essential role in the scheduling of preventive maintenance by assuring the availability of components and materials required for maintenance activities. It includes the planning, procurement, inventory management, and

monitoring of spare parts required for preventive maintenance duties. By maintaining an accurate inventory of spare parts, businesses can minimise disruption and reduce the risk of protracted maintenance periods caused by the unavailability of critical components. Industries that rely on machinery and equipment for operation must have efficient spare parts management (Sgarbossa et al., 2021). Effective spare parts management entails anticipating maintenance needs, establishing optimal supply levels, monitoring usage patterns, and establishing dependable supplier relationships. This ensures that the appropriate components are promptly available when required, which facilitates timely preventive maintenance activities. In addition, spare parts management optimises costs by preventing excessive inventory levels and minimising the risk of stockouts and obsolete inventory. By maintaining an effective spare parts management system, organisations can expedite preventive maintenance scheduling, improve asset dependability, and boost maintenance efficiency overall.

2.2.8 Resource Planning

Resource Planning is a crucial aspect of scheduling preventive maintenance because it ensures that the required resources are available and efficiently allocated for maintenance tasks. Resource planning is the practice of efficiently allocating resources to satisfy organizational demands (Simon et al., 2018). It entails the allocation of labour, apparatus, materials, and other essential resources to support preventive maintenance activities. The planning of resources considers factors such as the requisite skill sets, the availability of technicians, the availability of apparatus, and the availability of spare parts. By meticulously evaluating these factors, organisations can optimise resource utilisation and prevent

maintenance bottlenecks and delays. Effective resource planning permits the proper scheduling and sequencing of preventive maintenance tasks, ensuring that the appropriate resources are assigned to the appropriate tasks at the appropriate time. This strategy not only minimises delay, but also maximises productivity, reduces expenses, and improves the overall maintenance efficiency. By employing comprehensive resource planning strategies, organisations are able to manage and allocate resources proactively, resulting in enhanced asset reliability and optimised preventive maintenance scheduling.

2.2.9 Statistical Analysis

The statistical analysis of asset performance and failure patterns plays a crucial role in the scheduling of preventive maintenance. The process of gathering, examining, and interpreting data to reach judgments or reach conclusions is known as statistical analysis (Dasgupta & Gupta, 2019). It involves the accumulation, analysis, and interpretation of data pertaining to the maintenance history of assets, the surveillance of equipment health, and other pertinent factors. Through statistical techniques such as reliability analysis, failure rate estimation, and trend analysis, organisations can recognise patterns, foresee potential failures, and establish optimal maintenance intervals. Based on failure rates or deterioration trends, statistical analysis permits the identification of critical assets or components that require more frequent maintenance. It also aids in determining the efficacy of preventive maintenance strategies by comparing actual and expected failure rates. Utilising statistical analysis, organisations can make data-driven decisions to optimise preventive maintenance scheduling, decrease disruption, and more effectively allocate maintenance resources. This

strategy improves asset dependability, extends equipment life, and improves maintenance planning and execution overall.

2.2.10 Continuous Improvement

Continuous improvement is a key principle in scheduling preventive maintenance, aiming to enhance the effectiveness and efficiency of maintenance practices over time. Continuous improvement is the process of continuously evaluating and improving the current procedures, goods, or services in order to get better outcomes (Mena et al., 2021). It entails a methodical process of identifying areas for enhancement, implementing changes, and monitoring the outcomes to drive continuous improvement. By regularly reviewing and analysing maintenance processes, organisations can identify bottlenecks, inefficiencies, and optimisation opportunities. Continuous development in the scheduling of preventive maintenance may involve refining maintenance plans based on historical data and feedback, implementing more advanced condition monitoring techniques, or streamlining resource allocation and scheduling practises. Organisations can perpetually improve their preventive maintenance schedules by actively soliciting feedback from maintenance teams, evaluating performance metrics, and keeping abreast of new technologies and best practises. This iterative strategy fosters a culture of learning, innovation, and optimisation, resulting in increased asset reliability, decreased downtime, and enhanced maintenance efficiency.

2.3 Scheduling for Preventive Maintenance

Scheduling for preventive maintenance is crucial for manufacturing organizations since it increases the system's overall availability and reliability. It entails a range of actions intended to stop equipment breakdown and cut downtime (Hamedi et al., 2019). By establishing a well-planned schedule, businesses can effectively allocate resources, optimise maintenance activities, and reduce downtime, resulting in increased productivity and cost savings. Preventive maintenance increases the availability and reliability of equipment, lessens the consequences and causes of failure, and increases maintenance efficiency(Al-Hourani, 2020). By proactively addressing maintenance needs, businesses can increase equipment reliability, maximize productivity, and ultimately save time and resources in the long run. The factors of scheduling preventive maintenance include the time required for preventive maintenance, the frequency of preventive maintenance, the impact of preventive maintenance on machine availability and the impact of preventive maintenance on production scheduling and total tardiness (L. Chen et al., 2020). Table 2.2 illustrate the authors that talks about the factors of scheduling for preventive maintenance in their researches.

Table 2.2: Factors of Scheduling for Preventive Maintenance

Authors	Factor of Scheduling Preventive Maintenance
(Al-Hourani, 2020)	1. Safety and health 2. Environment 3. Alternative route/system 4. Quality 5. Good Manufacturing Practices (GMPs) 6. Production losses 7. Maintenance costs 8. Utilization percentages 9. Life expectancy

	10. Failure frequency 11. Equipment condition.
(Zhong et al., 2019)	1. Reliability 2. Cost
(Sin & Chung, 2020)	1. Electricity cost 2. Machine unavailability due to maintenance 3. Time-of-use pricing 4. Single machine scheduling problem 5. Bi-objective mixed-integer non-linear programming model 6. Hybrid multi-objective genetic algorithm (HMOGA) 7. α - and P-improvement methods for generating a better Pareto frontier
(Zhou & Lu, 2018)	1. Bidirectional interaction mechanism between station reliability and product quality 2. Station reliability evaluation method 3. Dynamic opportunistic preventive maintenance policy 4. Short-term cost savings from preventive maintenance stations and downstream stations.
(Duan et al., 2019)	1. Multiple maintenance objectives 2. Equal PM intervals in each phase 3. Age reduction factor as a function of maintenance cost and system age 4. Multi-attribute value model (MAVM) for maintenance modeling and optimizing problems.
(L. Li et al., 2021)	1. Availability 2. Cost
(Salgado Duarte et al., 2020)	1. Minimizing the risk of loss of load

	probability in the Power System 2. Non-linear stochastic optimization problem 3. Efficiently solved with Particle Swarm Optimization (PSO) and Genetic Algorithms (GA) 4. Allows Power System operators to establish the desired level of risk 5. Applied in a Cuban Power System isolated from the main national power grid with the presence of a wind farm in its energetic matrix
(Rooeinfar et al., 2019)	1. The uncertainty in the processing times of jobs 2. The limited buffer capacity, which can lead to congestion and delays 3. The fixed intervals at which preventive maintenance is performed 4. The trade-off between maintenance and production costs 5. The need to minimize make span (i.e., the time required to complete all jobs)
(Gehui (刘葛辉) et al., 2019)	1. Age-based maintenance strategy 2. Reliability-based maintenance strategy 3. Minimum reliability constraint for minimal cost rate
(L. Chen et al., 2020)	1. The time required for preventive maintenance 2. The frequency of preventive maintenance 3. The impact of preventive maintenance on machine availability 4. The impact of preventive maintenance on production scheduling and total tardiness

2.4 Factors of Scheduling for Preventive Maintenance

2.4.1 Maintenance Cost

When scheduling preventive maintenance, a number of factors influence the cost of maintenance. One of the most important factors is the total cost of ownership, which includes not only the direct costs associated with maintenance activities but also indirect costs such as delayed production, energy consumption, and potential safety hazards. The optimal frequency and timing of preventive maintenance tasks can be determined with the assistance of an evaluation of the maintenance's long-term costs. Age and condition of the assets are a further essential factor to consider. Older equipment may require more frequent maintenance, resulting in higher costs, whereas modern assets may require less maintenance. In addition, the cost and availability of spare parts, as well as the level of expertise required for maintenance duties, impact scheduling decisions. The following measures can be implemented to reduce costs implement preventive maintenance on a regular basis, determine the appropriate maintenance policy by analysing the frequency of failures, reduce the incidence of breakdowns by implementing a suitable maintenance policy, determine the total cost of maintenance for each maintenance policy and compare each policy's total cost of maintenance and select the one with the lowest price (Azizah et al., 2021). By meticulously analysing these factors, organisations can strike a balance between preserving asset dependability, minimising overall maintenance costs, and maximising asset longevity.

2.4.2 Environmental Factors

The scheduling of preventive maintenance is heavily influenced by environmental factors. Environmental factors that affect the effectiveness of preventive maintenance

treatments (PMTs) include freeze condition, moisture level, traffic level and pre-treatment pavement condition (Jia et al., 2021). When addressing environmental factors in preventive maintenance treatments (PMTs), it is important to take into account particular conditions such as freezing temperatures, moisture levels, and traffic volume. Assess the influence of these characteristics on the effectiveness of PMT by employing weighted distress and logistic regression analysis. Choose treatments that are engineered to last these circumstances and target specific issues, like as rutting and transverse cracking. Multiple techniques are employed for proactive maintenance, as environmental factors have a substantial influence on the dependability and efficiency of certain system (Sa'ad et al., 2021). By taking these parameters into account, one may evaluate the reliability of components and optimise maintenance procedures. The criticality of environmental factors aids in identifying components that are prone to degradation and failure mechanisms. To avoid failure, a proactive system is needed that can effectively and proactively maintains port equipment by taking into account external environmental conditions (Tangbin et al., 2015). The system can employs a statistical pattern recognition technique, rough set algorithm, and analytic hierarchy process to assess equipment failure rates and devise efficient preventive maintenance strategies, hence minimising consumption and waste in the contemporary manufacturing sector.

2.4.3 Machine's Life Expectancy

The life expectancy of a machine can influence the approach to preventative maintenance measures. Implementing regular and scheduled maintenance can effectively preserve the machine's condition and enhance its longevity (Andriani & Romli, 2020).

Nevertheless, failures may still happen prior to the scheduled maintenance date, leading to unforeseen malfunctions and interruptions in production (Nardo et al., 2021). Predictive maintenance seeks to consistently monitor the machine's state and proactively identify any malfunctions (Madan et al., 2022). Through the anticipation of machine malfunctions and the provision of early notifications to personnel, urgent repairs can be carried out to prevent financial losses (Purnachand, 2021). To anticipate the occurrence of crucial events in machines and industrial equipment, it is necessary to construct predictive maintenance frameworks that assess the probability of malfunction at any given moment. Different modelling methodologies can be employed, based on the utilisation and lifespan of the machine. Consistent surveillance and examination of machine performance data can detect recurring sequences and tendencies, allowing for preemptive maintenance measures.

2.4.4 Resources and Availability

Implementing preventive maintenance is essential in order to mitigate frequent system breakdowns and reduce management expenses. For Photovoltaic (PV) power plants, maintenance methods are formulated to enhance the dependability and accessibility of the system while also taking into account the cost considerations (Saad et al., 2022). To maintain smooth operation and uninterrupted power supply, resources and availability play a big rule. The process of scheduling preventive maintenance for complex machinery include models that consider costs, dependability, and resource constraints (Manzini et al., 2015). The framework partitions the planning horizon into pre-acquired temporal intervals, and tasks are allocated within the available intervals. The suggested framework takes into account the nominal frequency of tasks, emphasising the importance of resource availability in

preserving the desired timetable (Golpira & Tirkolaee, 2019). Precise assessment of work duration is essential for efficient scheduling. Availability-based warranty policies take into account the manufacturer's perspective and incorporate the impact of learning effects during the maintenance process (Su & Cheng, 2017).

2.4.5 Maintenance History

The maintenance history significantly influences the decisions made on preventive maintenance. Through the analysis of historical data, maintenance techniques can be optimised to minimise the adverse effects on output and enhance efficiency (Cha & Finkelstein, 2022). In addition, maintenance information systems can offer useful insights into the dependability of equipment and detect underperforming assets (Li et al., 2021). These systems utilise data analysis methods, such as text pattern algorithms, to extract patterns of failure from corrective work orders and evaluate the equilibrium between reactive and preventive maintenance efforts (Alia et al., 2022). Moreover, the utilisation of customised preventive maintenance lists and maintenance history lists could effectively guarantee that maintenance tasks are executed at the suitable moment, hence avoiding the possibility of neglected maintenance or excessive costs (Platfoot, 2014). Overall, possessing a comprehensive comprehension of the maintenance history enables one to make well-informed decisions and create efficient preventative maintenance strategies.

2.4.6 Time Requirement

The time requirement that impacts preventive maintenance is a crucial factor in engineering. According to Jiang et al. (2019), it is necessary to establish the timing for preventive maintenance and the interval reliability for electronic devices. The timing for preventative maintenance is established by considering elements such as service expenses, efficiency initiatives, and operational circumstances (Prodanov & Dankov, 2020). The selection of maintenance levels and the performance of multi-stage production systems are greatly influenced by time. According to Huang et al. (2018) the duration of maintenance actions and the deteriorating condition are directly correlated with the chosen maintenance level. The conditional probability of fail-time is determined by the age, scale, and form characteristics of the virtual machine. Time is also an important factor in estimating the loss of production caused by machine stoppage, which is essential for optimising expenses linked to maintenance.

2.5 Cultural Values

2.5.1 Definition of Culture

Dasgupta & Gupta (2019) define organisational culture as the shared values and beliefs of individuals within an organisation. Culture is the mental programming of the human mind, which influences thought patterns and moulds the institutions of society. Organisational culture is comprised of numerous elements, such as the organization's mission, vision, and objectives, its management practises, communication patterns, work environment, employee attitudes and behaviours, and its overall norms and customs (Hofstede, 2020). It is influenced by numerous factors, such as the organization's history, leadership style, industry, and workforce composition. Hora et al. (2019) emphasised that culture is a collective natural mentality that reveals a pattern of distinctive characteristics that have developed over time. Lowe et al. (2019) describe culture as a paradoxical "yin-yang" relationship between two opposing yet mutually constitutive aspects of the collective consciousness.

2.5.2 Cultural Dimensions

A cultural dimension is a preference that varies from one place, province, or nation to another (Hofstede, 2017). Cultural dimension refers to the different aspects of culture that can be measured and compared across different societies. These dimensions include values, beliefs, attitudes, and behaviors that are shared by members of a particular culture (Novianti, 2018). The term "cultural dimension" describes the component of a nation's brand image that is connected to its distinctive cultural connections and perceptions (Mariutti & Medeiros, 2018). It also refers to the various aspects of culture that can influence the behavior and

decision-making of individuals and organizations (W. S. Kim et al., 2020). Hofstede (1980) categorises cultural characteristics into four groups: individualism-collectivism, masculinity-femininity, uncertainty avoidance, and power distance. Long-short term oriented was a cultural characteristic that Hofstede introduced in 1993 and evaluated in 23 countries (Hofstede, 2017). In 2010, indulgence-restrain was added based in part on research by Michael Minkov, a Bulgarian sociologist and the inventor of the extensive World Values Survey (Chudnovskaya & O'Hara, 2022). Figure 2.2 shows the six cultural dimension by Hofstede.

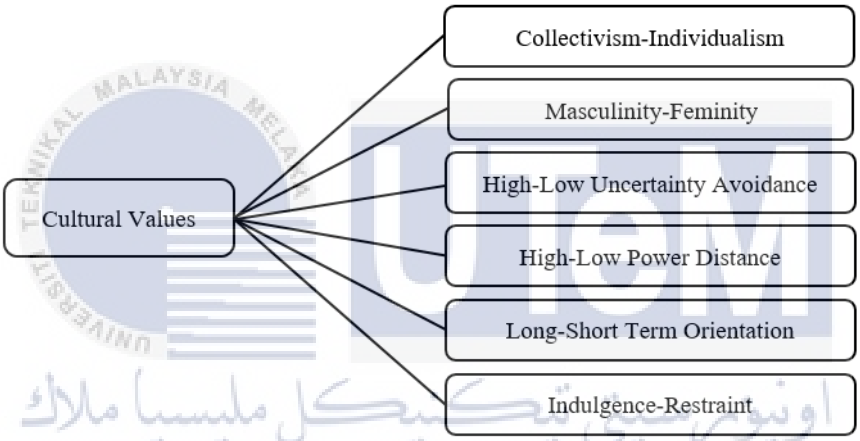

Figure 2.2: Hofsted 6 cultural dimension

2.5.3 Collectivism-Individualism

Individualism is the belief that business people create personal networks in order to participate in a wide range of learning activities (Schereurs et al., 2019). The emphasis on individual freedom, independence, accountability, self-satisfaction, and self-orientation is a cultural characteristic known as individualism (Gantenbein et al., 2019). For businesses that operate in such cultures and value individualism over collectivism, this could be an obstacle to overcome (Simas et al., 2018). The term "collectivism" describes a person's preference

for group interests over personal objectives (Menard et al., 2018). On context-based challenges, people performed better when the collectivist cultural attitude was applied (Arieli & Sagiv, 2018). People in collectivist cultures tend to define themselves as aspects of groups, prioritize in-group goals, focus on context more than content in communication, make more situational attributions, and tend to be self-effacing (Triandis, 2001). Preventive maintenance schedules may be determined by agreement in collectivism, with an emphasis on teamwork and ensuring the efficient use of common resources.

2.5.4 Masculinity-Femininity

Masculinity and femininity are the representations of the distinct gender roles, respectively. A stronger focus is placed on assertiveness, acquiring wealth, accomplishments, and success in the male-dominated culture. The feminine culture, on the other hand, places more value on looking out for others, maintaining a healthy lifestyle, and improving one's general quality of life (Ghazali et al., 2017). Despite improvements achieved by women in these professions over the past 40 years, there is still a significant gap between men and women in terms of scientific accomplishment, course taking, degrees earned, and professional positions held (Simon & Nene, 2018). A balance between performance and equipment care can be maintained by organizations by adjusting their preventive maintenance scheduling strategies according to cultural expectations by taking into account the cultural norms of masculinity or femininity.

2.5.5 High-Low Uncertainty Avoidance

Uncertainty avoidance is a cultural dimension that measures the risk-taking attitude of people(Jam et al., 2018). Uncertainty Avoidance is a cultural dimension that refers to the extent to which people in a society feel threatened by uncertain or unknown situations (De Meulenaer et al., 2018). A negative relationship exists between uncertainty avoidance and innovative work behavior and uncertainty cause a stressful state, people in an organization may be reluctant to adopt new ideas. (J. Kim & Fan, 2018). Preventive maintenance scheduling may be characterized by a conservative approach in cultures with high levels of uncertainty avoidance, which prioritize stability, regulations, and risk reduction. These societies frequently value frequent inspections, strict adherence to maintenance guidelines, and an emphasis on averting malfunctions or interruptions. The focus is on reducing uncertainty and making sure that there is a feeling of control over equipment performance. In contrast, societies with low levels of uncertainty avoidance are typically more at ease with ambivalence and risk-taking. Preventive maintenance planning may be more adaptable in these cultures, allowing for some experimentation and alterations in response to urgent situations and new data.

2.5.6 High-Low Power Distance

According to Farh et al. (2007), power distance is a cultural value that describes the extent to which people in a society tolerate and expect unequal distribution of power among individuals. (Lin et al., 2019) define power distance as the cultural value that determines the extent to which people in a society tolerate and expect unequal distribution of power. According to Gul et al. (2018), an individual's satisfaction with high power distance culture

is contingent on their cultural norms, as they prioritise cultural norms over their own requirements and desires. (Siddique et al., 2020) In a high power distance culture, employees who perceive their supervisors to be authoritarian are more likely to exhibit low job satisfaction and subpar performance in their current positions. In organisations with low power distance, where power and decision-making are distributed more equitably, preventive maintenance scheduling may involve more collaborative and data-driven approaches. In such environments, preventive maintenance scheduling is likely to be based on objective criteria, technical expertise, and a systematic evaluation of equipment requirements, ensuring that maintenance efforts are distributed across the organisation efficiently and effectively.

2.5.7 Long-Short Term Orientation

The term "long-term orientation" refers to the extent to which a culture rewards future-focused behaviours, such as determination, reserves, and preparation. People tend to focus on long-term goals and exhibit less spontaneous or impulsive behaviour in societies where long-term orientation is highly valued (Gul et al., 2018). Long-term or short-term orientation cultural norms may influence the scheduling of preventive maintenance. In cultures that emphasise perseverance, tenacity, and planning for the future, preventive maintenance scheduling is likely to adopt a proactive and strategic approach. These societies prioritise avoiding potential problems and making long-lasting equipment investments. In addition to short-term needs, maintenance schedules can be designed to accomplish long-term goals such as extending asset life or reducing lifecycle costs. In contrast, societies with a short-term orientation, which value fast results and agility, may schedule preventive

maintenance in a reactive manner. In lieu of long-term planning, the emphasis is placed on resolving imminent issues and ensuring the availability of equipment in the near future. By understanding the impact of long- or short-term orientation, organisations can align their preventive maintenance scheduling procedures with cultural norms and establish a balance between proactive planning and the need for quick results.

2.5.8 Indulgence-Restraint

The Indulgence and Restraint Cultural Dimension is a concept in cross-cultural psychology that refers to the extent to which people in a society indulge in their desires and impulses versus restraining themselves (Enkh-Amgalan, 2016). Cultural differences can impact the way a company's social and financial performance is perceived and evaluated in different regions of the world (Sun et al., 2019). Cultural dimension relating to indulgence and restraint can influence preventative maintenance scheduling. Preventive maintenance scheduling can encounter difficulties in civilizations represented by high indulgence, which prioritize fun, relaxation, and quick fulfillment. Short-term activities may be prioritized over long-term maintenance needs in such cultures. This may result in a disregard for preventive maintenance chores or a preference for reactive maintenance when problems develop. Preventive maintenance schedule, on the other hand, is likely to be undertaken with a more responsible and disciplined mindset in cultures defined by high restraint, which stress self-control, discipline, and delayed gratification. These cultures place a higher value on long-term stability and efficiency, which leads to a greater value on routine maintenance and devotion to scheduled inspections and repairs. Organizations can change their preventive maintenance scheduling procedures to meet with cultural expectations by considering the

cultural norms of indulgence or restraint. This ensures the correct care and repair of equipment for optimal performance and longevity.

2.6 Conceptual method development

2.6.1 Hypotheses and preference evaluation

Evaluation is an important part of course development, but it is often underutilized. Instructors may refrain from conducting evaluations due to concerns regarding the diversion of time and attention from the course topic (Balagiu et al., 2016). Nevertheless, integrating feedback and assessment systems into course materials can provide limited effects while offering advantages such as validation and direction for course improvement (Xiao & Wang, 2017). Furthermore, there is scientific evidence of significant language variances between research impact case studies that receive high ratings and those that receive low scores. This implies that the written style of the case studies might have an important part in determining the rankings, in addition to other factors (Reichard et al., 2020). According to Synder (2017), case studies that receive high scores typically include precise and impactful explanations of importance and impact, incorporate attributive language, and exhibit more cohesive and easily comprehensible writing. Case studies can additionally serve as a means to foster student involvement in main literature, enabling them to engage in data analysis and evaluation exercises (Lee et al., 2013). Usage Preferences (UPs) are defined as statistically significant preferences in language usage that might influence assessments of grammaticality and acceptability.

The utilisation of a hypothesis in determining a connection between factors of scheduling for preventive maintenance and cultural values is of important for various

reasons. Firstly, it offers a systematic method to comprehend the influence of cultural values on decision-making in maintenance scheduling. This help to develop well-informed hypotheses about how these values might affect priorities, allocation of resources, and attitudes towards maintenance methods. Furthermore, it is used to systematically investigate or examine the accuracy of these assumptions in various cultural settings, thereby revealing trends or connections that could contribute to the development of more culturally aware and efficient maintenance techniques. Finally, by developing a hypothesis, a basis is establised for collecting scientific information, which enables a more thorough understanding of how cultural values connect with maintenance scheduling. This, in turn, promotes the development of improved techniques that are in line with varied cultural values. Figure 2.3 illustrate the framework that will be used in this research.

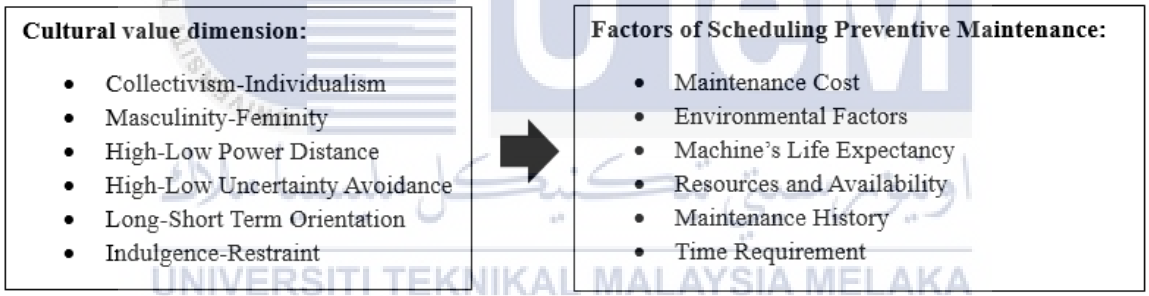

Figure 2.3: Framework to identify cultural value influences on factors of scheduling preventive maintenance.

Research hypotheses and the development of cultural value impacts on scheduling preventive maintenance can be found in Subsection 2.6.1.1 to 2.6.1.6.

2.6.1.1 Collectivism-Individualism

The study of individualism-collectivism has been conducted within the context of Malaysia. Studies have demonstrated a substantial correlation between individualism-collectivism and an individual's inclination to donate organs. Specifically, collectivism is favourably linked to intentions of organ donation (Chen & Chen, 2023). According to (Oxford, 2023) in the retail industry, both individuality and collectivism affect customer service satisfaction. However, collectivism has a more significant impact on overall satisfaction levels. Moreover, a comparative analysis of managers in Malaysia and Australia revealed notable disparities in the degrees of individualism and collectivism observed in the two nations, particularly in relation to vertical individualism, horizontal collectivism, and vertical collectivism (Li & Niu, 2023).

H1: Collectivism has a significant influence towards the scheduling for preventive maintenance.

2.6.1.2 Masculinity-Feminitiy

The cultural understanding of masculinity in Malaysia is intricate and constantly changing. Conventional ideas about masculinity, such as the qualities of being dominant and muscular, are no longer regarded as the ultimate defining characteristics of masculinity. Conversely, qualities such as independence, competitiveness, and a willingness to take risks are regarded as significant factors in one's perception of masculinity (Hassan & Ramli, 2022). The creation of masculinity in Malaysia is shaped by multiple elements, such as cultural norms, institutions, and the interplay of different aspects of one's identity (Latiff ,

2022). The conformity to socially constructed masculine norms among adolescent motorcyclists has been seen to foster engagement in illicit racing and aggressive conduct, serving as a means to showcase dominance and masculinity (Hussin & Ahmad, 2022). In Malaysia, the perception and interpretation of masculinity are shaped by cultural, social, and individual aspects (Radzi et al., 2018*)*. This emphasises the importance of developing a nuanced awareness of masculinity in the country. Moreover, research on gender roles in Malaysian men has revealed that devotion to traditional masculinity, specifically, promotes views that favour injustice against women (Endut et al., 2020). In certain sectors of Malaysian society that are shaped by masculine cultural norms, there may be a heightened focus on technical accuracy and efficiency when it comes to scheduling maintenance tasks.

H2: Masculinity has a significant influence towards the scheduling for preventive maintenance.

2.6.1.3 High-Low Uncertainty Avoidance

Malaysia exhibits a high level of uncertainty avoidance, as evidenced by multiple research. Wahab et al. (2021) discovered that implementing high-commitment work systems has a substantial good influence on the performance of a company and a notable negative impact on employee burnout. However, it does not have a significant positive effect on employee wellbeing. According to Amira's (2015) research demonstrated that the level of sensitivity to uncertainty has a detrimental impact on the willingness of international students to embrace Malay cuisine. Badru and Zaluki's (2018) research demonstrated that the Malaysian IPO (Initial Public Offering) market, which is defined by fixed price offerings and cautious investors, diverges from the prior to uncertainty hypothesis. Belkhamza and

Wafa's (2014) research established that uncertainty avoidance significantly influences the adoption of e-commerce in Malaysia. These findings collectively suggest that Malaysia exhibits high-uncertainty avoidance tendencies in several areas.

H3: Higher uncertainty avoidance has a significant influence towards the scheduling for preventive maintenance.

2.6.1.4 High-Low Power Distance

According to Aminuddin and Mustaffa (2023) a cultural trait prevalent in Malaysia is high power distance, in which individuals unquestioningly embrace and anticipate an imbalance of power. The societal ideals strongly include this hierarchical system. Adversarial dispute resolution systems, such as adjudication, may not align well with cultures that have a high power distance, as they can lead to social tensions and conflicts over authority (Shah & Mittal, 2023). In Malaysian cultural environments that prioritise increased power distance, it is believed that there is a greater tendency to strictly follow predetermined maintenance schedules. The hierarchical structure could enhance a stronger sense of duty and conformity among subordinate personnel to rigorously follow schedules established by higher authority.

H4: High power distance has a significant influence towards the scheduling for preventive maintenance.

2.6.1.5 Long-Short Term Orientation

The concept of long-term orientation has been studied in diverse situations within Malaysia. A study examined the correlation between long-term orientation, innovation, and firm performance in high-performing organisations (Ku et al., 2023). A separate investigation examined the financial framework of small and medium firms (SMEs) operating in the food and beverage sector. The study discovered that the presence of long-term debt had a crucial role in determining the capital structure used by SMEs for their financing needs (Saif et al., 2018). Furthermore, a study conducted an analysis on the correlation between economic activity and the stock market in Malaysia and discovered a possible long-term cointegrating relationship between the two variables (Suriaty, 2017). These studies emphasise the significance of a long-term perspective in several elements of business and economic performance in Malaysia. A emphasis on sustainable maintenance scheduling procedures may exist within segments influenced by a long-term viewpoint. According to this concept, maintenance plans may prioritise investments in durable equipment, proactive maintenance procedures, and long-term solutions in order to achieve continuous efficiency and asset longevity.

H5: Long-term orientation has a significant influence towards the scheduling for preventive maintenance.

2.6.1.6 Indulgence-Restraint

Indulgence and restraint are significant cultural characteristics that can have an impact on multiple areas in Malaysia. A study examining corruption within law enforcement agencies revealed that both familial pressure and personal influence were influential factors

in engaging in corrupt activities (Norziaton & Sabri, 2022). A further study examined the impact of indulgence vs restraint in service interactions within the tourist and hospitality industry, emphasising its consequences for both clients and service personnel (Eskandari et al., 2018). In addition, the study investigated the frequency of using physical restraints in hospitals, and found that the highest rate was observed in neurology-neurosurgery wards (Koc et al., 2017). Moreover, an examination was conducted on the utilisation of child restraint systems (CRS) in automobiles, which uncovered a significant prevalence of improper usage. This highlights the necessity for initiatives aimed at raising awareness and providing educational programmes to encourage correct CRS utilisation (‘Indulgence versus Restraint’, 2019). Collectively, these studies underscore the significance of comprehending and tackling the concepts of excess and restraint in diverse situations within Malaysia.

H6: Being indulgence has a significant influence towards the scheduling for preventive maintenance.

In order to determine the cultural value impacts that are relevant to the aspect of scheduling for preventive maintenance, six hypotheses have been developed. The six hypotheses have been established in order to determine the effect of cultural values on the factors of scheduling for preventive maintenance. Table 2.3 illustrate a compilation of the six developed hypotheses that would need to be validated by the results of this investigation.

Table 2.2: Hypotheses of the research

Cultural values	Hypotheses
Collectivism	**H1:** Collectivism has a significant influence towards the scheduling for preventive maintenance
Masculinity	**H2:** Masculinity has a significant influence towards the scheduling for preventive maintenance.
Uncertainty avoidance	**H3:** Higher uncertainty avoidance has a significant influence towards the scheduling for preventive maintenance.
Power Distance	**H4:** High power distance has a significant influence towards the scheduling for preventive maintenance.
Long-term orientation	**H5:** Long-term orientation has a significant influence towards the scheduling for preventive maintenance.
Indulgence	**H6:** Being indulgence has a significant influence towards the scheduling for preventive maintenance.

2.6.2 Literature Supporting Sources

When working on research, it is critical to study supporting literature to acquire relevant and credible information. Scholarly articles, academic journals, books, conference papers, dissertations, and respected websites can all be used as sources for supporting literature. These sources provide as a basis for existing knowledge and research in a particular field or issue. Scholarly publications and academic journals are especially significant since they are subjected to a rigorous peer-review procedure, which ensures the accuracy and credibility of the information given. Books are also useful because they often provide in-depth coverage of a subject. Conference papers and dissertations provide information about current research trends and new ideas. Reputable websites, such as those linked with educational institutions, government agencies, or well-known groups, can also

be useful sources of information. To ensure the accuracy and value of the information for the research, it is crucial to carefully analyze the credibility, relevance, and currency of the literature supporting sources.

2.7 Research Gap Discussion

There are a lot of researches, journal and books regarding scheduling for preventive maintenance. Some of the examples are Gehui et al. (2019), L. Li et al. (2021), Zhou & Lu, (2018), Ye et al. (2021) and (Liu et al., 2018). The current research on the evaluation of scheduling for preventive maintenance with culture values in Malaysia reveals a notable gap in comprehending the intricate interaction between cultural values and maintenance scheduling practices within particular industries or organisational contexts. Although certain studies have examined the impact of cultural dimensions like power distance or uncertainty avoidance on overall organisational practices, there is a lack of extensive research specifically investigating the complex connection between cultural values and the development, execution, and efficacy of preventive maintenance scheduling strategies in Malaysian industries. Furthermore, there is a lack of extensive research on the specific influence of cultural dimensions such as individualism-collectivism, masculinity-femininity, long-term orientation, and indulgence-restraint, and their different levels, on decision-making processes, resource allocation, and maintenance scheduling in various sectors or organisational structures in Malaysia.

2.8 Summary

This review examines the impact of cultural values on maintenance scheduling decisions inside organisations. Implementing preventive maintenance is essential in order to avert equipment failure and prolong the Mean Time Between Failures. Various tools such as computerised management systems, reliability-centered maintenance, condition-based maintenance, time-based maintenance, PM optimisation, failure modes and consequences analysis, spare parts management, resource planning, and continuous improvement are employed for the purpose of scheduling maintenance tasks. The scheduling process is influenced by several factors, including the overall cost of owning the assets, the age and condition of the assets, the availability of spare parts, and the level of skill needed for maintenance tasks. Through the analysis of these characteristics, organisations may achieve a balance between the reliability of their assets, cost reduction, and the optimisation of their lifespan. The scheduling of preventive maintenance is influenced by various elements such as environmental factors, resource availability, maintenance history, time requirement, cultural values, and cultural factors all influence the scheduling of preventive maintenance. Gaining insight into these cultural norms can facilitate the synchronisation of preventive maintenance scheduling methods with long-term objectives and foster the advancement of enhanced techniques that accord with diverse cultural values. These findings have been validated and insights into the elements influencing scheduling for preventative maintenance in Malaysia have been provided through the development of six hypotheses. A compilation of the research gaps, aim and objectives are presented in Figure 2.4.

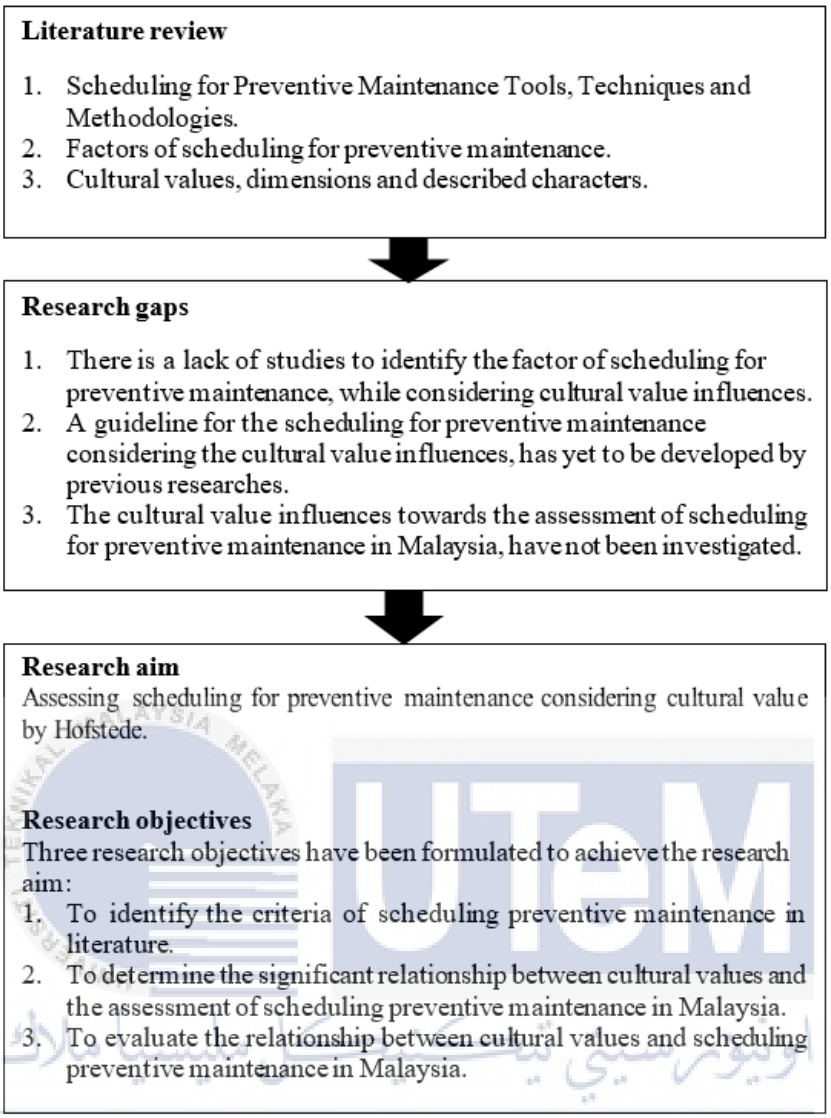

Figure 2.4: Compilation of research gaps, aim and objectives

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter describes the methodology utilised in this research titled "The Assessment of Scheduling for Preventive Maintenance Considering Cultural Value." The research procedure consisted of four several phases. In the initial phase, the primary objective was to examine the impact of cultural values on the scheduling for preventive maintenance in order to increase productivity. Manufacturers were interviewed about their company's cultural orientation and implementation of scheduling for preventive maintenance in order to collect data essential to this phase. This data enabled a thorough comprehension of the manufacturers' perspectives on the cultural values that must be considered when implementing preventive maintenance. The subsequent phase consisted of the extraction of scheduling for preventive maintenance methods from extant literature and prior research, which served as a framework for the manufacturers' developed strategies. After collecting and analysing data from manufacturers, the next stage involved formulating guidelines that take cultural values into consideration during the application of scheduling for preventive maintenance methods. The development of these guidelines was informed by customer and manufacturer’s opinions as well as existing literature. Subsequently, the proposed guidelines were validated to determine their effectiveness in boosting productivity through scheduling for preventive maintenance.

3.2 Research Design

Research is the systematic investigation of a topic or issue using scientific methodologies to generate new knowledge or validate existing information(Hampshaw et al., 2018). Research is crucial for increasing human knowledge, enriching science, and promoting progress in health, quality of life, and innovation. It enables questions about behavior, natural phenomena, and improves outcomes. Research enriches productive systems, attracts resources, and establishes scientific projects with potential profitability (McLennan, 2019). It contributes to knowledge and should be socialized through publications. The metrics measure journal quality and academic performance, especially in biomedical research and interdisciplinary teams are Journal Impact Factor (IF) and h-index (Grech & Rizk, 2018).

The historical ontology of quantitative research methods, specifically statistics and probability, have always been value-laden (Zyphur & Pierides, 2020). It traces the invention of these methods to their adoption as a logic separate from ethics and values. Quantitative research focuses on collecting and analyzing numerical data through methods like surveys, experiments, and statistical analysis, providing a generalizable and objective understanding of a phenomenon. Quantitative research design is a research methodology utilizing numerical data to test hypotheses and answer questions in scientific studies (Bloomfield & Fisher, 2019).

Qualitative interview is a research method used to gather in-depth information about people's experiences, opinions, and attitudes (Newington et al., 2022). Qualitative research analyzes subjective experiences through interviews, focus groups, and observations to identify themes and patterns (Hutter et al., 2011). The indistinguishability thesis asserts that

it is impossible to distinguish between qualitative and quantitative research, based on essentialism (Morgan, 2018). Qualitative research focuses on understanding human behavior, attitudes, and experiences through interviews, observations, and case studies, while quantitative research collects and analyzes numerical data through surveys, experiments, and statistical analysis. Both approaches aim to provide a generalizable and objective understanding of a phenomenon.

Table 3.1: Difference between Quantitative & Qualitative

Criteria	**Quantitative**	**Qualitative**
Method	Experimental: The researcher's objective is to determine the specific outcome by testing multiple treatments that affect the outcome. Non-experimental: The researcher focuses on providing quantitative data, such as population trends, behaviours, and opinions, by sampling the population.	Ethnography: a method that examines the natural environment over a period of time by accumulating data predominantly through observation and interviews. Grounded theory: the researcher obtains a broad, abstract theory of method, action, or interactions based on participant analysis. Case studies: the researcher focuses on the investigation of an event, activity, program's profundity, or procedure. Phenomenological research: to understand the phenomenon of human experiences as described by respondents or participants.
Objective	The researcher examines the theory and hypotheses, constructs facts, predicts behaviour, and statistically explains an event.	The researcher identifies broad patterns, generalisations, or theories based on themes or categories.
Item in research instrumen	Many objects are usable; the items themselves contain selection	Open-ended questions, few things, and no suggested responses.

t	suggestions.	
Data collection	Utilising questionnaires, structured observations, and interviews, data can be collected. The majority of explanations involve numbers and quantities, measurement scales, or computations.	Utilised observation that was not structured, interviews, and documentation. Notes that are descriptive and verbal, a recording of an observation or interview, supporting documentation, and a transcript.
Data analysis	It may consist of descriptive statistics, inferential statistics, parametric and nonparametric tests.	There are numerous data analysis techniques, including domain analysis, taxonomy analysis, hermeneutical analysis, and coding.

A mixed-methods study is a research strategy that combines qualitative and quantitative approaches to data collection and analysis (Seyed Fatemi et al., 1397). Consequently, this required both qualitative and quantitative data collection and analysis. If the researcher believes that either approach is insufficient to achieve the research objective, he or she may also employ a mixed method.

There are a number of criteria to consider when deciding between quantitative, qualitative, and mix research methods. Consideration should be returned to the research problems and the achievement of research objectives. The first objective of this study was to identify the optimal scheduling time for preventive maintenance based on cultural influences. The objective is to investigated how cultural influences could affect the scheduling decisions for maintenance tasks.

The second objective was to identify the cultural dimension that impact the determination of scheduling preventive maintenance. This goal can be attained by evaluating the developed hypotheses with statistical methods. The critical threshold of a research is extracted using exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The next stage is to substantiate the hypotheses using structural equation modelling (SEM) once the critical thresholds for EFA and CFA have been reached. The quantitative method is the more appropriate approach for achieving this research goal.

The third objective was to evaluate the relationship between cultural values and scheduling preventive maintenance in Malaysia. With this evaluation, practical recommendation and strategies to implement cultural value analysis for performing scheduling preventive maintenance can be provided. The practical recommendations and strategies provided by the study would serve as guidance for practitioners or organizations seeking to consider cultural factors in their preventive maintenance scheduling processes.

In order to achieve research objectives 1 through 3, quantitative and qualitative research designs were more appropriate for this study. This is because statistical analysis is required to calculate the intensity of the relationship between cultural value influences and scheduling for preventive maintenance. Statistical analysis was used to predict the relative importance of scheduling preventive maintenance, taking into account the influence of cultural value. The qualitative research design was also chosen because interviews were necessary for this study in order to identify the right way to decide the scheduling for preventive maintenance and cultural values consideration from the expert perspective.

3.3 Flow Chart

Flowcharts are essential in research technique since they show the sequential processes and decision points of the research process. Every phase, ranging from problem conceptualization to data analysis, can be seen using distinct shapes and connectors, offering a straightforward and organised roadmap for researchers. This visual representation facilitates a methodical and structured approach to research, enabling researchers to foresee probable obstacles and assuring a coherent sequence of actions. Figure 3.1 shows the flowchart of the methods used in this study.

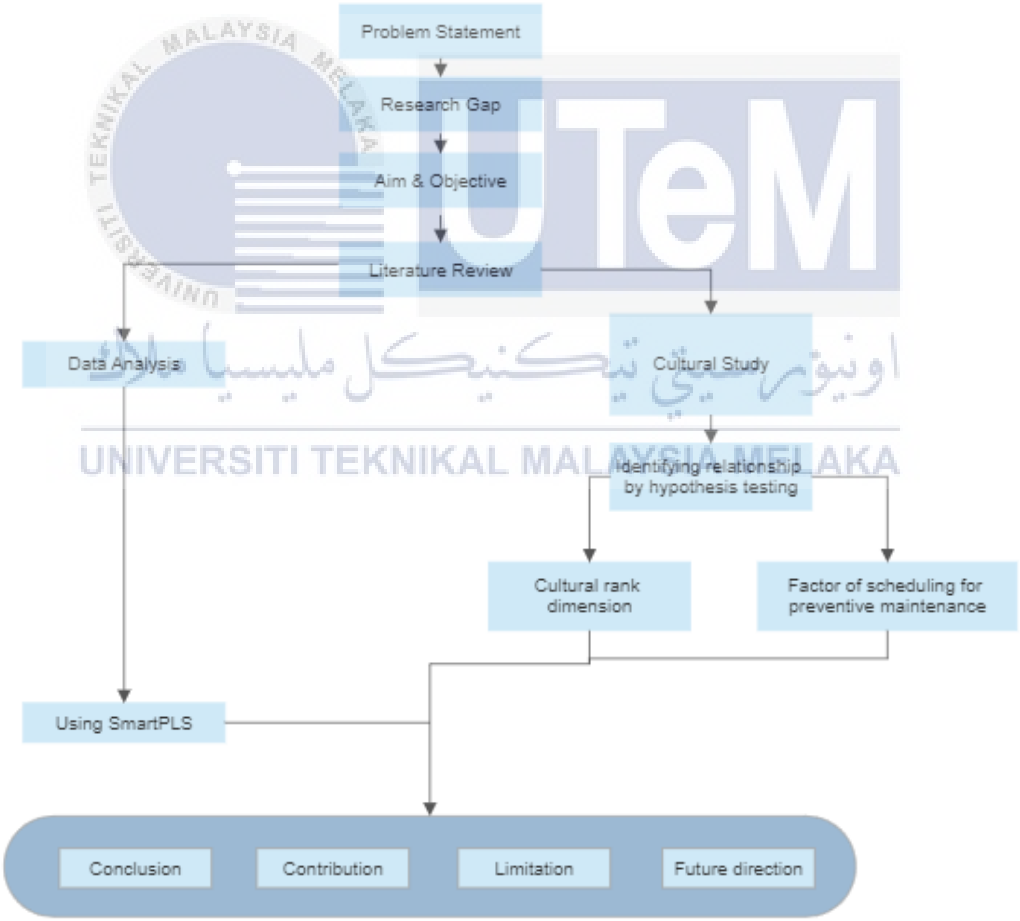

Figure 3.1: Research Methodology Used In This Study

3.4 Data Collection

Researchers should consider using a mixed-mode approach to increase response rates and reduce nonresponse bias (Mulder & Bruijne, 2019). This means that researchers should consider using both online and paper-based methods to collect data from participants in order to improve the quality of their study results. Online methods can be more convenient for participants, as they can complete questionnaires at their own pace and from the comfort of their own homes (van Gelder et al., 2020). According to Benitez et al., (2020), there are two different kinds of data that may be used in a research project. These two forms of data are known as primary data and secondary data (Ghazali et al., 2017). Primary user data refers to the first-hand experience that designers have with users' problems and task environments. This data is collected through various user research methods. On the other hand, secondary user data refers to data that has already been collected by someone else, such as market research reports or academic studies (Dahiya & Kumar, 2019). According to Hair et al. (2019), the process of collecting primary data can be divided into several categories, including observation, subject interviews, questionnaires and schedules, and other similar activities. For secondary data, it can be collected via statistical reports, databases, annual reports of corporations, demographic data, government publications of economic indicator data, and so on. Benitez et al. (2020) define secondary data as information that has been collected, investigated, and analysed by someone else or other researchers.

3.4.1 Proposed Methodology

The proposed methodology for this research entails collecting data from study participants using a questionnaire-based approach. The questionnaire will be generated with

effort to collect applicable data and insights relevant to the research objectives. It will consist of a series of written queries that enable the systematic collection and examination of data. The questionnaire will be created based on a comprehensive review of the extant literature and pertinent theories, ensuring that it captures the most important variables and concepts. A questionnaire will be given to the participants, who were chosen using a purposive sampling technique, asking them to answer with their thoughts, experiences, and viewpoints on the study's subject. The collected data will then be analysed using appropriate statistical methods, including descriptive statistics and inferential analysis, in order to draw meaningful conclusions and address the research questions. This methodology will provide a thorough and efficient approach to collecting and analysing data, allowing for an in-depth study of the research topic and ensuring a solid foundation for the thesis' findings and recommendations.

3.4.2 Questionnaire Development

According to Taherdoost (2019), questionnaire is a research tool used by decision makers and researchers across all academic and industry sectors to uncover answers to specific, significant questions. It is an effective tool for data collection required for research and evaluation. The questionnaire for this research was created using a focused approach centred on agree/disagree questions. The questionnaire will be designed to capture the perspectives and opinions of participants regarding the research topic. A comprehensive review of relevant literature and theories will guide the development of the questions, ensuring that the items faithfully reflect the research objectives. Each question will contain a research-related statement or assertion, and respondents will be asked to indicate their level of agreement or disagreement with the statement using a Likert scale or a comparable scale.

The questionnaire will be meticulously organised to preserve clarity and coherence, thereby minimising ambiguity and confusion. The use of agree/disagree questions will streamline the data collection procedure and make analysis easier. By utilising this targeted approach to questionnaire creation, the thesis will be able to collect valuable insights and opinions from participants, thereby enabling a thorough examination of the research topic.

3.4.3 Design of The Questionnaire

The purpose of a series of questionnaires was to obtain input from each participant and determine additional requirements and expectations regarding the proposed study. Google Forms was used to create an evaluation form that takes cultural preferences into account and is intended to evaluate the factor of scheduling for preventive maintenance for productivity improvement. Based on the responses of the respondents, the cultural significance of this achievement is evaluated (Ghazali et al., 2017). Within the scope of this inquiry, the questionnaire is divided into three distinct sections. The elements pertaining to the respondents' demographic information can be found in the first section of the document. The contents of the following two sections are comprised of items associated with the model's employed construct. This section provides an overview of the descriptions that follow each section.

i) Part A

This section includes six queries regarding age, gender, marital status, academic qualification and salary range. Respondents were instructed to select any option

for each question. This section provides essential information for the discussion and analysis

ii) Part B

The following section comprises a total of thirty items that reflect the six cultural values previously mentioned. Five items each were designated to the collectivism, masculinity, power distance, uncertainty avoidance, term orientation and indulgence categories. In the survey, a concise explanation was provided for each cultural dimension in an effort to reduce the level of confusion among respondents regarding the meanings of the terms associated with the cultural dimensions included in the questionnaire

iii) Part C

This section is consisting of six characteristics of the factor of scheduling for preventive maintenance. These characteristics include maintenance cost, environmental factor, machine life's expectancy, resources and availability, maintenance history, and time requirement. Respondents were instructed to indicate the relative importance of each answer choice by checking the appropriate boxes in the designated columns. Table 3.1 provides a summary of all of the items in the questionnaire that have been given a successful implementation.

Table 3.1: Construct and items in the questionnaire

Construct	Number of items	Sources
Collectivism	5 items	CVSCALE; Yoo et al. (2011).
Masculinity	5 items	
Uncertainty avoidance	5 items	
Power distance	5 items	
Long-term orientation	5 items	
Indulgence	5 items	
Maintenance Cost	5 items	Literature review
Environmental Factor	5 items	Literature review
Machine Life's Expectancy	5 items	Literature review
Resource and Availability	5 items	Literature review
Maintenance History	5 items	Literature review
Time Requirement	5 items	Literature review
Total	60 items	

3.4.4 Scale of questionnaire

A scale is a tool for analysing an idea created by combining multiple scores with a series of questions (Kock & Hadaya, 2018). This study's primary objective was to identify the thirty cultural factors that influence scheduling for preventive maintenance for the purpose of increasing productivity. In this study, the responses of the respondents to the items were measured using a Likert scale because it is easy to use, the respondents can provide their own responses, and the Likert scale has greater reliability than other scales (Nallusamy et al., 2015). We used a Likert scale with a range of 1 to 7 in order to reduce respondents' errors and increase the dependability of the data (Hofstede, 2011). 1 on the scale indicated "strongly disagree," whereas 7 indicated "strongly agree" for the statements regarding culture in Part B and scheduling for preventive maintenance in Part C. Appendix B contains the questionnaire in its entirety.

3.4.5 Population and Sample

The respondent for the data collection was collected from manufacturing industry background. This study focused on workers from Etika Beverages Sdn. Bhd. and Knit Textiles Sdn. Bhd. The data collected got 36 respondents from both companies.

3.5 The usage of PLS-SEM

In this study, the hypotheses included in the research framework were evaluated using the PLS-SEM technique. There is a chance that the proposed model would have a complex connection. Within the proposed conceptual framework, there were twelve distinct constructs and a substantial number of indicators. There were six cultural dimensions, each with thirty indicators, that pointed to the factor of scheduling for preventive maintenance in order to increase productivity. There are a total of thirty indicators and six conceptions that comprise the factor of preventive maintenance scheduling for increasing productivity. As a result, the PLS-SEM has been deemed the optimal method because it does not limit the number of variables that can be included in the analysis. Each primary criterion may be evaluated based on a number of sub-criteria. Both the relevance of the criterion and the significance of the sub criteria are verifiable. Figure 3.3 below shows the number of constructs and indicators examined in this study.

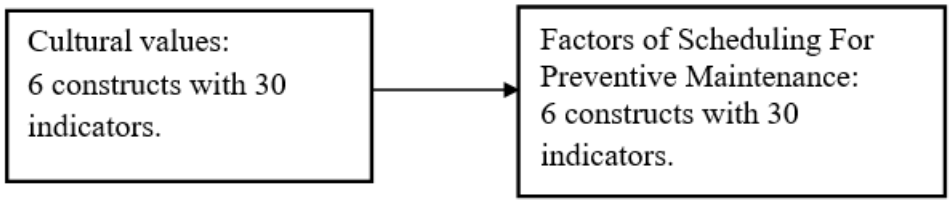

Figure 3.2: Number of Construct and Indicators

In addition, the research aimed to evaluate the effect of the cultural values construct on the factor of scheduling for preventive maintenance in order to increase productivity. According to Hair et al. (2019), the sample size has no bearing on the PLS-SEM. This is due to the fact that a small sample size can still provide a high degree of statistical power, whereas a larger sample size can provide greater consistency in the analysis. Since there are multiple levels of data validation and the measurement error was taken into account during data analysis, the outer weight produced by the SEM has a higher level of validity. PLS-SEM was able to estimate or evaluate the error that was acquired during the measurement process because it can incorporate both observed and unobserved measurements or latent variables. Consequently, the findings of the PLS-SEM can be utilized in future research, such as in the process of calculating the outer weight of indicators as a forecast of the productivity enhancement that can be achieved through the scheduling for preventive maintenance.

3.5.1 Specifying measurement model

The construct, the indicator, and the measurement model are the three most important concepts to highlight when analysing the study framework. A construct, also known as a latent variable, is the measurement of abstract, complex, and intangible concepts that cannot be directly observed by many objects. The measurement of these concepts is the definition of a construct (Hair et al., 2019). Constructs in path models are depicted as either circles or ovals. Indicators are directly measured observations, also referred to as raw data, and are commonly referred to as the items or manifest variables. Indicators in path models are

depicted as rectangles. In addition, these are the accessible data used to measure the latent variables with measurement models. For instance, the responses to survey queries or the data obtained from business databases. In structural equation modelling, the indicators are typically called manifest variables (Hair et al., 2019). A measurement model is an element of a path model that is composed of indicators and the relationships between those indicators and the constructs. The measurement model is also known as the peripheral model in the PLS-SEM.

Cultural values comprise six aspects. These characteristics were considered when determining which constructs or latent variables should be evaluated in this study. Each dimension contains indicators, which serve to communicate the significance of each dimension. It is characterised by collectivism, masculinity, power distance, uncertainty avoidance, long term and indulgence. The analysis's indicators should each be assigned a unique identifier so that they can be distinguished from one another and the process can be simplified. Table 3.3 to Table 3.8 show details of the indicators and their corresponding constructions.

Table 3.2: Collectivism Indicator

Collectivism indicators	Code
People should put the group they are a part of ahead of their own needs.	cvm1
Even when things are hard, people should stick with the group.	cvm2
The group's well-being is more important than individual gains.	cvm3
The success of the group is more important than the success of any one person.	cvm4
People should be told to stick with the group even if it means giving up their own goals.	cvm5

Table 3.3: Masculinity Indicators

Masculinity indicators	Code
Having a successful career is more crucial for males than it is for women.	mcy1
Men are more likely to use logic and reason to figure things out, while women are more likely to trust their emotions.	mcy2
Men typically use an aggressive, violent approach to solving difficult situations.	mcy3
A guy can always perform some tasks better than a woman.	mcy4
In our society, being strong and tough are seen as good qualities.	mcy5

Table 3.4: Uncertainty Avoidance Indicator

Uncertainty Avoidance indicators	Code
I need instructions that are very clear and specific so I always know what to do.	uae1
It is important to follow directions and steps very carefully.	uae2
Standardized work procedures are helpful.	uae3
Rules and regulations are significant because they let me know what is required of me.	uae4
It is important to have instructions for tasks.	uae5

Table 3.5: Power Distance Indicator

Power Distance indicators	Code
Most decisions should be made by those in higher positions without involving those in lower positions.	pde1
The opinions of those in lower positions shouldn't be asked too frequently by those in higher positions.	pde2
Social connections with those in lower positions should be avoided by those in higher positions.	pde3
People in high position shouldn't give important jobs to people in lower position.	pde4
Decisions taken by those in higher positions should not be fought by those in lower positions.	pde5

Table 3.6: Long Term Orientation

Long Term Orientation indicators	Code
Taking good care of financial management.	lto1
Persistence is the quality of continuing despite obstacles.	lto2
Stagnation and stability of the self.	lto3
Long-term planning.	lto4
Putting up a lot of effort to achieve success in the future.	lto5

Table 3.7: Indulgence Indicator

Indulgence indicators	Code
I often treat myself with enjoyable things, even if they are not required.	ige1
I believe it is important to reward myself for my hard work and achievements.	ige2
I believe in enjoying the present moment rather than worrying too much about the future.	ige3
I believe that life is too short to deny oneself simple pleasures and comforts.	ige4
I think it's important to put my own fun and happiness first, even if that means going against what society says I should do.	ige5

There are six different elements that form the factor of scheduling for preventive maintenance. Tables 3.9 to Table 3.14 each contain an explanation of a different construct, together with the indicators and codes used for analysis of that construct.

Table 3.8: Maintenance Cost Indicator

Maintenance Cost indicators	Code
The existing preventative maintenance routine efficiently reduces unwanted costs for repairs.	mct1
Performing scheduled preventive maintenance tasks has an obvious beneficial effect on decreasing total maintenance costs.	mct2
The specified budget for preventative maintenance appears to be reasonable, given the cost savings it offers by preventing significant breakdowns.	mct3
Maintenance expenses could be reduced greatly by optimizing our preventive maintenance schedule.	mct4
Reductions in repair costs serve as clear evidence of the return on investment generated by the routine preventive maintenance operations.	mct5

Table 3.9: Environmental Factors Indicator

Environmental Factors indicators	**Code**
Severe temperatures or humidity have a significant effect on the level of preventive maintenance needed for equipment.	efs1
Exposure to environmental variables such as salt and chemicals significantly increases the risk of corrosion and damage to machinery, which requires more frequent maintenance checks.	efs2
Elevated levels of dust or pollution in our working environment amplify the frequency of maintenance necessary for our equipment.	efs3
The preventive maintenance schedule we employ takes into consideration the possibility that equipment functionality may be negatively impacted by natural disasters or extreme weather events.	efs4
The ongoing surveillance of environmental conditions is critical in order to optimise the schedule for preventive maintenance and minimise equipment failures.	efs5

Table 3.10: Machine Life's Expectancy

Machine's Life Expectancy indicators	**Code**
Commitment to regular preventive maintenance helps to the machine's maintained optimal performance over its entire lifespan.	mle1
Proper preventive maintenance conserves the wear and strain on our machinery, extending its operating life.	mle2
Predictive maintenance solutions extend the overall lifespan of equipment significantly.	mle3
Neglecting of carrying out preventive maintenance frequently significantly reduces the estimated lifespan of machinery.	mle4
Applying technological advances with our preventive maintenance method improves machine lifespan.	mle5

Table 3.11: Resource and Availability Indicators

Resources and Availability indicators	Code
Skilled staff necessary to perform preventive maintenance are always accessible when needed.	raa1
Maintenance tools and equipment are easily accessible and quickly available for scheduled maintenance work.	raa2
We have regular access to essential replacement parts for maintenance, minimising downtime due to unavailability.	raa3
Throughout the year, resource availability stays consistent, ensuring that preventative maintenance routines are not disrupted.	raa4
The availability of resources is directly linked to the success and utility of our preventative maintenance initiatives.	raa5

Table 3.12: Maintenance History Indicator

Maintenance History indicators	Code
Previous preventative maintenance schedules have been shown to be effective in reducing unexpected breakdowns.	mhy1
Historical maintenance events played a role in the improvement of the present preventive maintenance strategy.	mhy2
Previous maintenance failures or breakdowns have given significant knowledge into improving existing preventive maintenance routines.	mhy3
Past projections regarding maintenance requirements have been mostly correct, assisting in the development of future preventive maintenance plans.	mhy4
The analysis gained from our past maintenance records is reliable and useful in designing our present preventative maintenance programmes.	mhy5

Table 3.13: Time Requirement Indicator

Time Requirement indicators	Code
The amount of time needed to accomplish the activities must be carefully considered when scheduling preventative maintenance.	trt1
The time given for preventative maintenance tasks is sufficient to cover the needs for thorough equipment examinations and repair.	trt2
Our preventive maintenance initiatives allows for flexible time allocation, allowing us to accommodate unanticipated repair needs without causing severe interruptions.	trt3
Preventive maintenance time that is properly allocated lowers overall equipment downtime due to unforeseen malfunctions.	trt4
Preventive maintenance performed on time provides straightforward operational continuity with no unexpected interruptions.	trt5

Justification of the measuring model for each of the constructs is required in order to ascertain the cultural values and influence factor of scheduling for preventive maintenance. Either a reflective or formative approach to measurement may be used. According to Hair et al. (2019), the choice between using reflective or formative measurements depends on the conceptualization of the construct and the study's objectives. This decision is not black-and-white, is still being debated in a variety of disciplines, and has not been conclusively determined. Table 3.15 outlines the factors that should be considered when choosing between formative and reflective assessments.

Table 3.14: The consideration for using formative or reflective measurements

Reflective	Formative
From the construct to be measured is the direction of causality.	The indicators are regarded as the construct's defining characteristics.
It is expected that indicators will be correlated.	Changes in the indicators are anticipated to result in modifications to the construct.
Eliminating an indicator from the measurement model does not alter the construct's meaning.	Changes to the construct are not anticipated to affect the indicators.
Takes into consideration measurement error at the item level.	The indicators may or may not have a common theme.
The same as factor analysis.	Eliminating an indicator may alter the construct's conceptual domain.
Typical of management and social science studies.	A change in the value of one indicator is not necessarily associated with a change in the values of the remaining indicators.
	The indicators are not anticipated to have identical causes and effects.

The arrowheads of the construct in the reflective and formative measurement models differ, as shown in Figure 3.4. For reflective measurement, arrowheads point from the construct to the indicators, whereas for formative measurement, they point from the indicators to the construct. The subsequent section discusses the methodology for analysing the reflective and formative measurements.

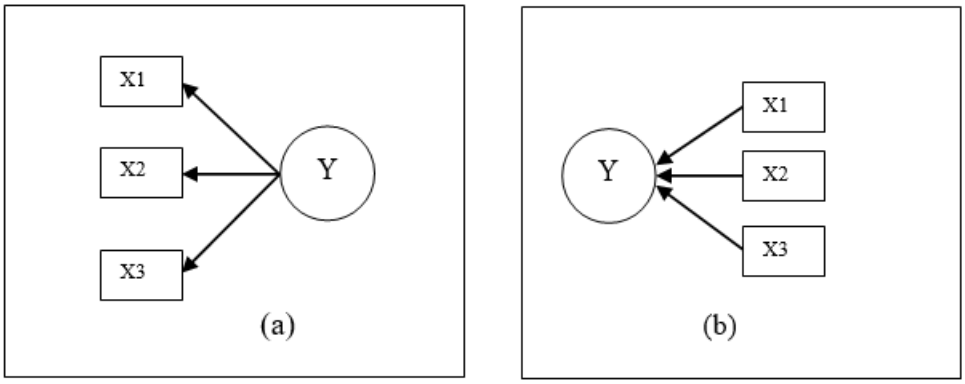

Figure 3.3: The (a) reflective and (b) formative measurement models

The reflective measurement model is assessed through three procedures: identifying internal consistency (CR) and convergent validity (AVE), identifying collinearity issues (VIF), and assessing the significance and relevancies of formative indicators. The critical threshold for internal consistency is 0.6-0.7, while CR should be higher than 0.6 for exploratory research. Convergent validity is determined by examining indicator reliability and average variance extracted (AVE). The heterotrait-monotrait ratio (HTMT) approach is used to evaluate discriminant validity, with a value below 0.85.

For formative measurement, the critical threshold loading should be higher than 0.5, and the outer weight should be significant for interpretation. Collinearity issues are identified by examining the variance inflation factor (VIF) value, which should be less than 5. The significance and relevancies of formative indicators are assessed using the bootstrapping procedure. If the indicator shows statistical significance of 1%, 5%, and 10%, and the loading is higher than 0.5, the indicator should be retained.

The structural model is assessed through six steps: identifying collinearity issues, assessing the path coefficient, evaluating the coefficient of determination (R2), assessing the effect size (f2), evaluating predictive relevance (Q2), and assessing the effect size (q2). The critical thresholds for these procedures are 0.02, 0.15, and 0.35, respectively. The structural

model's significance and relevance are also assessed, with values between 0.02, 0.15, and 0.35 being considered small, medium, and large. The study focuses on the evaluation of a structural model using high-order or hierarchical component models (HCM) in PLS-SEM. HCM is a higher-order structure that contains multiple layers of constructs and involves a higher level of abstraction.

It reduces the number of relationships in the structural model, making the path model in the PLS-SEM more parsimonious and easier to understand. HCM has four types: reflective-reflective, reflective-formative, formative-reflective, and formative-formative. The two-stages approach simplifies the relationship between the structural model and path measurement for HCM analysis.

The HOC-LOC classification is used to identify the relationship between the LOC and HOC. The LOC consist of maintenance cost, environmental factor, machine life's expectancy, resources and availability, maintenance history and time requirement. To identify the relationship between the LOC and HOC, all indicators of the LOC were manifested as the indicator in the HOC.

The reflective-formative measurement model was used to analyze the cultural value and customer preferences constructs. The indicators for the six cultural dimensions were classified as reflective measurement models, as they were highly correlated to predict cultural dimensions. Maintenance cost, environmental factor, machine life's expectancy, resources and availability, maintenance history and time requirement were considered LOC, while factors of scheduling for preventive maintenance was considered HOC.

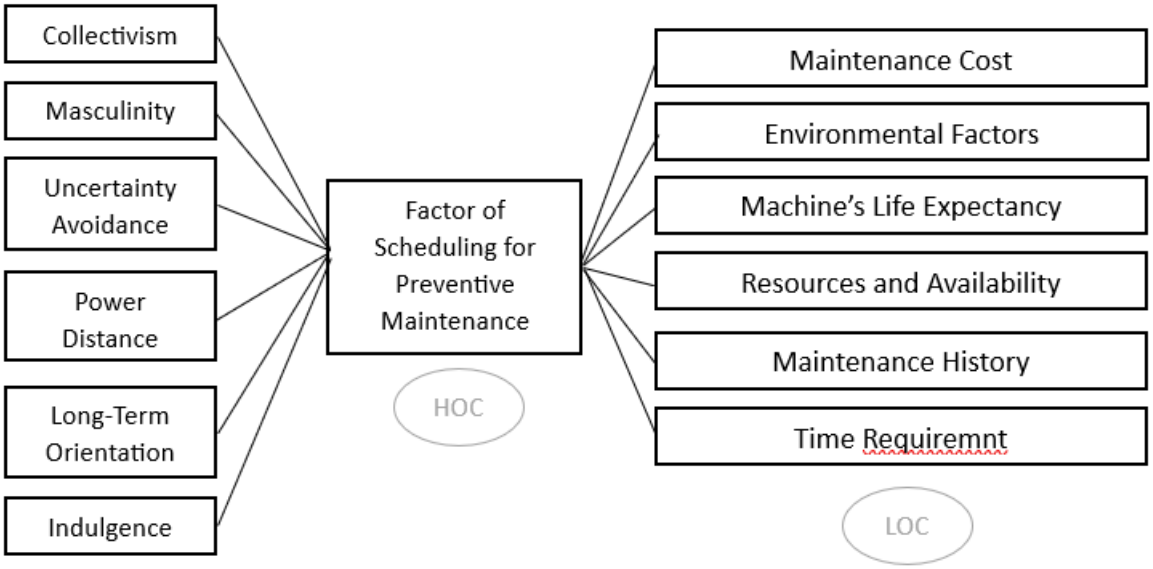

Figure 3.4: The HOC-LOC classification

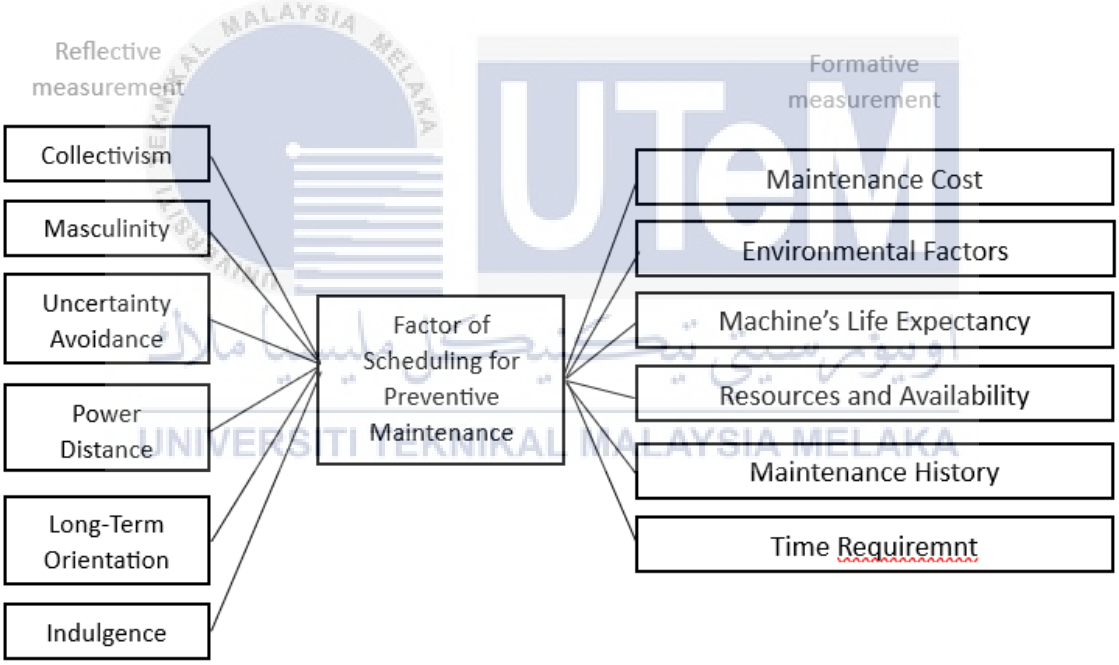

Figure 3.5: The classification of construct measurement

3.6 Summary

The purpose of this chapter was to elaborate the overall method used in identifying the influence of cultural values towards factor of scheduling for preventive maintenance. The method used for the data collection and analysis have been clearly described. The identification of scheduling for preventive maintenance considering cultural values have indirectly resulted inthe achievement of the research objective. These results were validated in order for it to be practiced. A guideline for considering the cultural value influences in making the best scheduling for preventive maintenance. The implementation of the methodology explained in this chapter, was described in Chapter 4.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This chapter is divided into three main sections. Each of the sections have their important roles. The first section examines the approach used to analyse the impact of cultural values on the schedule for preventive maintenance. This analysis included collecting insights from the viewpoints of employees in manufacturing industry which are Etika Beverages Sdn Bhd in Selangor and Knit Textiles Sdn. Bhd. In Johor. The descriptive analyses included identifying the respondents, managing missing data, evaluating the sufficiency of the sample, and analysing the reliability of the data. After reaching a comprehensive stage of analysis, the next step involved testing hypotheses in order to determine the impact of cultural dimensions, such as collectivism, individualism, masculinity, femininity, uncertainty avoidance, power distance, long-term versus short-term orientation, and indulgence versus restraint on preventive maintenance scheduling. This was accomplished by carefully examining the specified criteria of critical significance for statistical calculations. To fully understand the effectiveness of scheduling preventive maintenance, it was necessary to calculate the output of the outside weight for the construct of preventive maintenance factors. This facilitated the identification of the important factors that impact the scheduling process. However, it was necessary to assess and confirm all important benchmarks before examining the structural model. The next section of the paper outlines the analytical methodology used to determine the impact of cultural values on scheduling for preventive maintenance. The final part will focus on a particular real-life event or situation where the results and predictions obtained from the previous studies are

implemented. This could demonstrate how the cultural effects mentioned earlier affect or appear in a real industrial or organisational environment during the implementation or enhancement of preventive maintenance scheduling. The case study could provide a comprehensive account of a company's implementation of changes in its preventative maintenance scheduling methods, taking into account of the cultural factors. The article should emphasise the difficulties encountered, the tactics employed, and the clear relationship between cultural factors and the efficiency of their maintenance programmes.

4.2 Respondent perspective

4.2.1 Descriptive analysis

This study carried out by using google form to collect data. The selection of this method was based on its user-friendly interface, ability to be customised to specific needs, and its practicality in collecting data from a total of 36 participants from two separate manufacturing companies. The Google Form was carefully crafted to include inquiries that are in line with cultural values and the scheduling of preventive maintenance. The questions explored participants' perspectives on teamwork, individualism, attitudes towards uncertainty, authority structures, scheduling experiences, obstacles encountered, and factors influencing maintenance strategies. The gathered data received thorough descriptive analysis, which included diligent data cleansing to guarantee correctness and comprehensiveness. We calculated fundamental statistical measures to summarise the replies, revealing primary tendencies and significant patterns. The use of Google Forms for data collection was crucial in quick acquiring complete insights, allowing for a full analysis of the intersection of cultural values and decision-making processes in preventative

maintenance scheduling. Employing SmartPLS for structural equation modelling (SEM) analysis with a sample size of 36 participants are sufficient under specific circumstances. SmartPLS is advantageous due to its superior capability in managing smaller sample sizes in comparison to alternative methodologies. If the correlations in examining between cultural values and preventative maintenance elements are simple to identify and not excessively complex this sample size is suitable. Moreover, even with a limited number of responders, the insights provided by a varied range of opinions can be highly beneficial. Although the sample size is small, it can nonetheless offer dependable insights into the influence of cultural values on maintenance planning, particularly if the relationships being investigated are significant. 30.6% of the respondents were in the age range of 16 to 24 years old, followed by 38.9% in the age range of 25 to 34 years old, followed by 11.1% in the age range of 35 to 44 years old, followed by 16.7% in the age range of 45 to 54 years old, and 2.8% in the age range of 55 and 64. The respondents were made of 24 males (66.7%) and 12 females (33.3%).

4.2.2 Confirmatory analysis

The CFA was conducted using the Partial Least Squares (PLS) method. The Smart-PLS programme was employed to perform a statistical analysis of the data. The measuring model includes reflecting measures as part of its structure. The use of Hierarchical Cluster Analysis (HCM) was used to determine the correlations between constructs of the factors of scheduling for preventive maintenance and cultural values. The factors of scheduling for preventive maintenance are maintenance cost, environmental factors, machine's life expectancy, resources and availability, maintenance history and time requirement. For

cultural values dimension, high-low power distance, individualism versus collectivism, masculinity versus feminity, high-low uncertainty avoidance, long-short term orientation and indulgence versus restraint.

4.2.2.1 Convergent validity

To ensure the accuracy of a reflective measurement model, conducting a convergent validity test becomes imperative, assessing factor loadings (ideally between 0.4 and 0.7 or higher), composite reliability (CR > 0.7), and average variance extracted (AVE > 0.5). While a CR within the range of 0.6 to 0.7 might be suitable for exploratory investigations (Kock & Hadaya, 2018), improving AVE and CR by potentially removing items with the lowest factor loadings could refine the model, enhancing the reliability of the measurements and ensuring better convergence among related constructs. Figure 4.1 below illustrates the computing procedure that is used to determine whether or not the data have convergent validity.

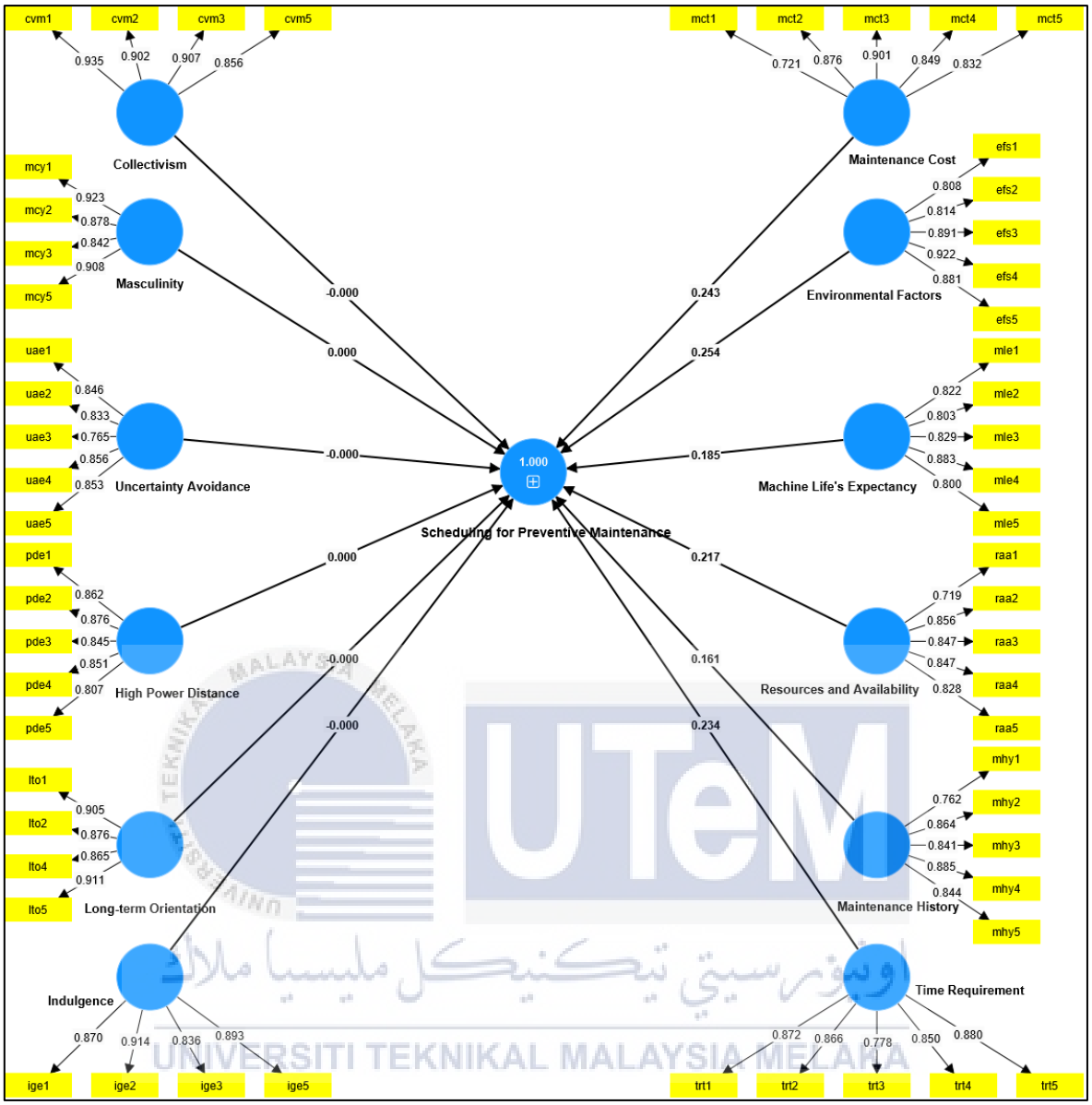

Figure 4.1: Outer loading computatiom

Several lowest elements in factor loading were deleted from the outer loading computation above to provide the genuine convergent validity. Lto2 for latent variable long-term orientation, mcy4 for masculinity, cvm4 for collectivism and ige4 for indulgence with the lowest outer loading score have been deleted. Table 4.1 summarises factor loadings, average variance estimates, and cross-validated reliability.

Table 4.1: Compilation of factor loading, AVE and CR values

Cultural Dimension	Items	AVE	CR
Collectivism	cvm1 cvm2 cvm3 cvm4	0.811	0.945
Masculinity	mcy1 mcy2 mcy3 mcy5	0.789	0.937
Uncertainty avoidance	uae1 uae2 uae3 uae4 uae5	0.691	0.918
High Power distance	pde1 pde2 pde3 pde4 pde5	0.720	0.928
Long-term orientation	lto1 lto2 lto4 lto5	0.791	0.938
Indulgence	ige1 ige2 ige3 ige5	0.773	0.931

AVE is the average variance extracted (should be > 0.5)
CR is composite reliability (should be > 0.7; 0.60 to 0.70 is acceptable for exploratory study

The AVE and CR values have all succeeded in their respective critical levels, as shown in Table above. As a result of proving the convergent validity, the computation can now proceed to verify the discriminant validity.

4.2.2.2 Discriminant validity

After confirming the convergent validity through examination, the subsequent step involved the validation of the discriminant aspects within the research framework. Discriminant validity, defined as the extent to which a particular construct can be distinguished from other constructs based on empirical criteria (Hair et al., 2019), was systematically scrutinized to ensure the robustness of the measurement model. A pivotal metric employed for this evaluation was the Heterotrait-Monotrait (HTMT) ratio, a widely recognized criterion in literature (Singh et al., 2018). This ratio is indicative of the degree to which constructs differ from each other. It necessitates that the HTMT value must be less than 0.85 to establish a clear demarcation between constructs. Table 4.2 encapsulates the outcomes derived from the HTMT assessment, providing a comprehensive overview of the discriminant validity examination. The critical threshold of 0.85 serves as a benchmark, ensuring that each construct exhibits a discernible separation from others within the research context. This robust examination not only reinforces the convergent validity but also bolsters the overall reliability and integrity of the research model.

Table 4.2: Heterotrait-Monotrait Ratio (HTMT) for discriminant validity

	Collectivism	Indulgence	Long-term Orientation	Masculinity	Power Distance	Uncertainty Avoidance
Collectivism						
Indulgence	0.799					
Long-term Orientation	0.792	0.788				
Masculinity	0.719	0.627	0.732			
High Power Distance	0.374	0.406	0.401	0.522		
Uncertainty Avoidance	0.271	0.314	0.198	0.222	0.749	0.134

To prove discriminant validity, the HTMT number must be less than 0.85.

4.2.2.3 Formative measurement model

After examining the reflective measures for convergent and discriminant validity, we turned our attention to analysing and evaluating the reflective measuring methods. This method required investigating six major components which are maintenance cost, environmental factors, machine's life expectancy, resources and availability, maintenance history and time requirement. To assess the efficiency of the reflected measurement, we used two crucial indicators which are the Variance Inflation Factor (VIF) and the outer loading. Hair et al. (2019) state that for a reliable reflective measurement, both the VIF and outer loading values should be more than 0.5. Table 4.3 summarises the findings of the VIF analysis. All VIF values related with the indicators for maintenance cost, environmental factors, machine's life expectancy, resources and availability, maintenance history and time requirement were discovered to be less than 5. This observation is critical since it indicates that there are no collinearity issues in the data. In simpler terms, our study of the reflective measurement methods, taking into account many components, demonstrated that the data is dependable and devoid of collinearity problems. This ensures that our measurement technique is robust in capturing the critical features of scheduling for preventive maintenance factors.

Table 4.3**:** Variance inflation factor (VIF)

ITEM		**VIF**
Maintenance Cost	mct1	1.731
	mct2	3.032
	mct3	4.548
	mct4	3.520
	mct5	2.215
Environmental Factors	efs1	2.024
	efs2	2.385
	efs3	3.507
	efs4	4.478
	efs5	3.400
Machine's Life Expectancy	mle1	3.016
	mle2	2.770
	mle3	2.171
	mle4	3.562
	mle5	2.503
Resources and Availability	raa1	1.597
	raa2	2.825
	raa3	2.936
	raa4	2.753
	raa5	2.411
Maintenance History	mhy1	1.968
	mhy2	2.849
	mhy3	2.572
	mhy4	3.748
	mhy5	2.742
Time Requirement	trt1	2.832
	trt2	2.788
	trt3	1.890
	trt4	2.871
	trt5	3.408

Collinearity problems are shown by VIF > 5.

4.2.3 Structural modeling

Next, we analyzed the relationships between the five cultural value dimensions and the construct associated with scheduling for preventive maintenance components. Upon completing the calculations, it became apparent that the external loadings for the constructs of maintenance cost, environmental factors, machine's life expectancy, resources and availability, maintenance history and time requirement. These deficiencies resulted from repeated signals in the reflective-reflective measurements for several aspects, such as maintenance cost, environmental factors, machine's life expectancy, resources and availability, maintenance history and time requirement. According to Hair et al. (2019), using both formative-formative and reflective-formative assessments in the Human Capital Management (HCM) model can lead to a small loading and significant connection. Occasionally, the R2 (variance explained) can reach a value of 1, as shown in Figure 4.2 for the loading of the scheduling for preventive maintenance construct. In order to tackle this difficulty, a two-stage Human Capital Management (HCM) analysis was conducted. This entailed obtaining the values of latent variable scores for the construct measurements and converting these constructs into novel indicators. The strategic technique was utilized to address the concerns identified in the reflective-reflective measurements, guaranteeing a more precise depiction of the connections between the cultural value dimensions and the scheduling for preventive maintenance elements (Durana et al., 2019).

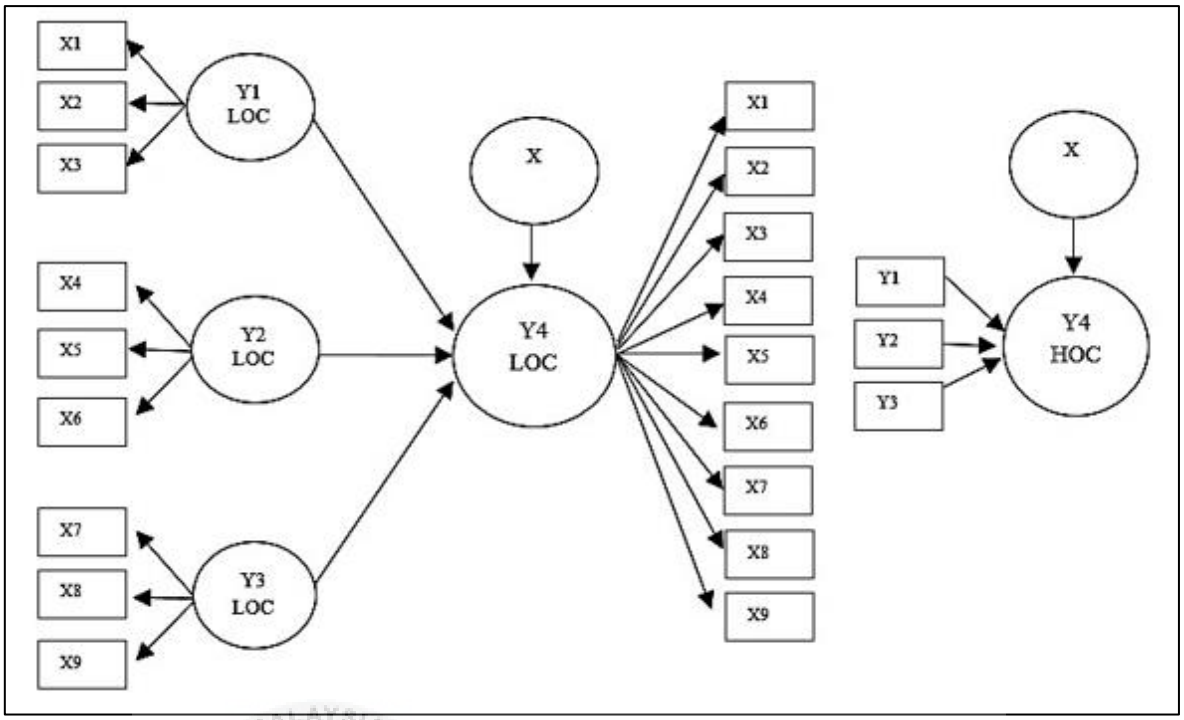

Figure 4.2: Two-stage analysis is conducted in the field of human capital management (HCM). The constructs can be converted into new indicators by utilizing their latent variable scores (Hair et al., 2019).

In order to transform the constructs of maintenance cost, environmental factors, machine's life expectancy, resources and availability, maintenance history and time requirement into new indicators, we will utilize the extracted latent variable scores of each construct in the first stage. To have a proper understanding, it is recommended to consult the research conducted by Hair et al. (2019) and examine Figure 4.2, which provides a detailed explanation of the two-stage analysis. After transforming these four conceptions into novel indicators, the subsequent task was establishing the relationships between the six cultural value dimensions that were associated with the framework of the factor of scheduling for preventive maintenance. This was accomplished subsequent to the completion of the transition procedure. The t-value evaluation is the procedure used to determine the significance of connections. The t-value is the established criterion used to ascertain the

significance of a coefficient. To ensure a precise study of the t-values, it was recommended to do bootstrapping with 5,000 distinct subsamples.

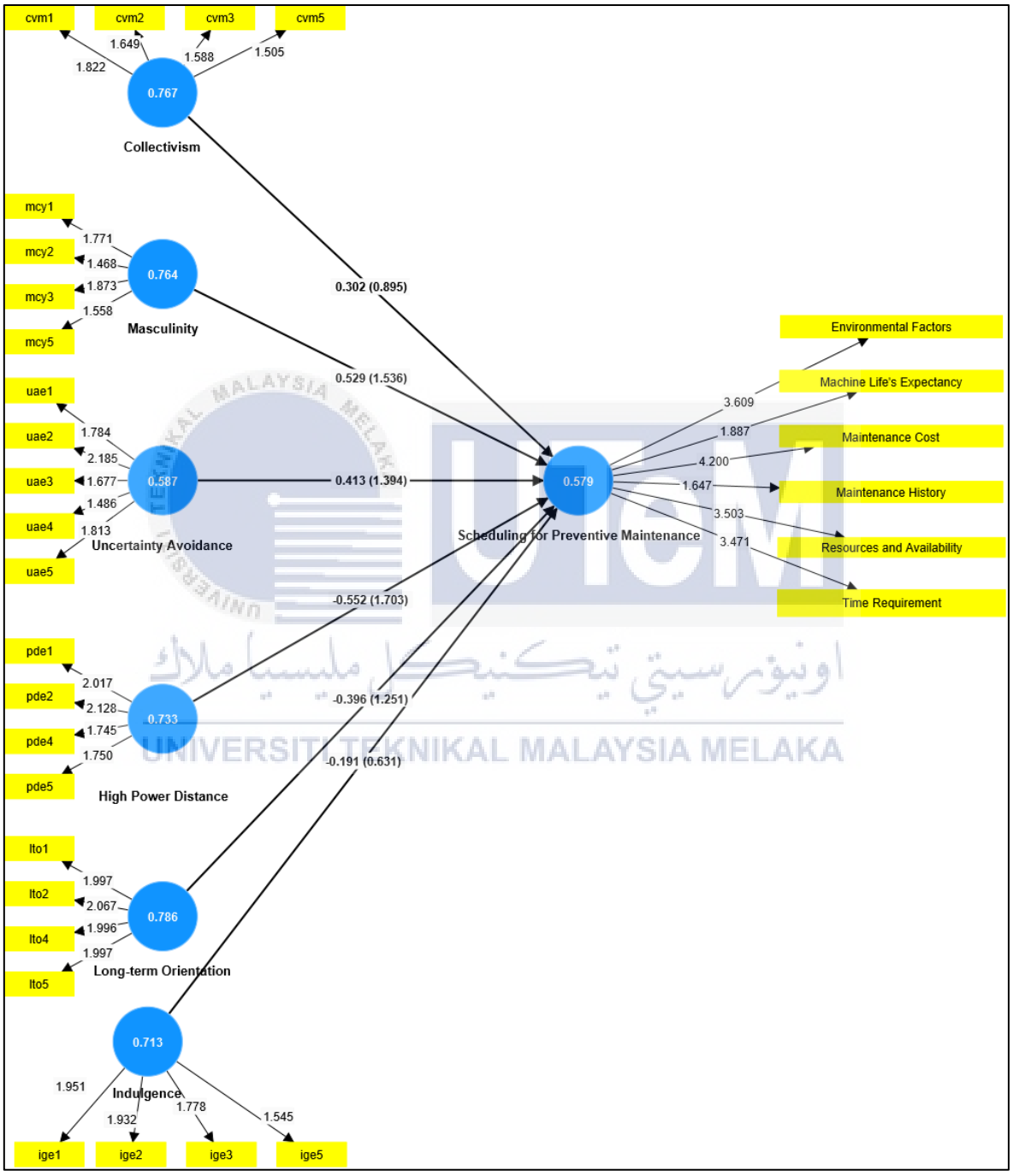

Figure 4.3: Structural modeling computation

Figure 4.3 exhibits the data gathered to illustrate the correlation between the cultural value dimension and the construct of lean manufacturing processes. Several things have been eliminated from the outer loading to extract the significant data. The values for collectivism (cvm4), masculinity (mcy4), high power distance (pde3), long-term orientation (lto3) and indulgence (ige4) have been removed.

Table 4.4: Results of the structural equation model

Hyp.	**Description**	**Path coefficient**	**Standard deviation**	***t*-value**	**Result**
H1	High Power Distance →Scheduling for preventive maintenance	-0.552	0.324	1.703	Supported
H2	Collectivism → Scheduling for preventive maintenance	0.302	0.337	0.895	Not supported
H3	Masculinity → Scheduling for preventive maintenance	0.529	0.344	1.536	Not supported
H4	Uncertainty avoidance → Scheduling for preventive maintenance	0.413	0.296	1.394	Not supported
H5	Long-term orientation → Scheduling for preventive maintenance	-0.396	0.317	1.251	Not supported
H6	Indulgence → Scheduling for preventive maintenance	-0.191	0.303	0.631	Not supported

The critical t-values were 2.57, 1.96, and 1.65, respectively, for the 1%, 5%, and 10% significance levels. According to Table 4.4, it was discovered that the factors of high power distance (β = -0.552, $p < 0.1$) have significant influence towards the scheduling for preventive maintenance considering cultural value, whereas the factors of collectivism, masculinity, uncertainty avoidance, long-term orientation and indulgence do not have any significant influence towards the evaluation of work system design considering cultural value.

4.2.4 Assessing R^2 (Coefficient of determination)

The coefficient of determination, denoted as R2, was computed in the subsequent step after identifying the primary connections of the structural model. The coefficient of determination for a construct can be seen as a quantification of the proportion of its variability that can be accounted for by the constructs that act as its predictors. The significance of R2 varies based on the specific subject of study being undertaken. The possible values are 0.75, 0.5, or 0.25, each corresponding to a distinct level of strength: considerable, moderate, or weak. In their study, Hair et al. (2019) suggested utilising the modified R2 value during regression analysis to prevent any bias towards more intricate models. The formula provided below can be utilised to calculate the adjusted R2 value:

$$R^2adj = 1 - (1-R^2)\frac{n-1}{n-k-1}$$

The symbol n represents the size of the sample, whereas the variable k denotes the number of exogenous latent variables used to forecast the endogenous latent variables under consideration. Starting from Smart-PLS version 4.0, the corrected R2 value is now immediately accessible. The execution of the bootstrapping technique is necessary to generate it. Similar to the previous research conducted on the relationships among the five cultural value impacts, 5000 subsamples were examined to ascertain the coefficient of determination.

Table 4.5: The result for the R^2 and adjusted R^2

Construct	Adjusted R^2	R^2
Scheduling for Preventive Maintenance	0.244	0.374

4.2.5 Assessing the effect size (f^2)

Within the scope of investigating utilising Partial Least Squares Structural Equation Modelling (PLS-SEM), we conducted a thorough analysis to evaluate the effect size (f^2) of the relationship between the construct of six cultural value dimensions and the factor of scheduling for preventive maintenance. The calculation of effect size (f^2) is of utmost importance as it seeks to quantify the practical impact of these connections. It is important to investigate the level to which differences in scheduling for preventative maintenance can be attributed to the impact of cultural value dimensions. Through careful examination of these impact size metrics, a detailed comprehension of the magnitude and practical significance of the identified correlations is provided. These insights are crucial for a deep understanding of the complex dynamics that define the relationship between cultural values and the scheduling practices for preventive maintenance in our study. The profound analysis conducted during this inquiry not only strengthens the theoretical foundations but also provides valuable insights for enterprises or organisations dealing with the interaction between cultural values and maintenance scheduling. Table 4.6 summarizes the results of the effect size for all the constructions.

Table 4.6: Results of the effect size (f2) for the construct of the factor of scheduling for preventive maintenance.

Construct	**Effect size (f^2)**
Collectivism	0.027
Indulgence	0.005
Long-term orientation	0.088
Masculinity	0.144
High Power Distance	0.375
Uncertainty Avoidance	0.119

The effect size (f^2) findings for the construct of the factor of scheduling for preventative maintenance demonstrate diverse levels of influence from the six cultural value dimensions. Collectivism has a small effect size of 0.027, suggesting that it has a limited but noticeable impact on scheduling decisions. Indulgence, with an effect size of 0.005, demonstrates a small influence. On the other hand, long-term orientation has a significant effect size of 0.088, indicating a notable impact on the scheduling for preventive maintenance construct. The effect size of 0.144 indicates that masculinity has a big impact, emphasising its significance in influencing scheduling patterns. The factor of high power distance has the biggest impact on the scheduling construct, as seen by its effect size of 0.375. Furthermore, uncertainty avoidance has a significant effect size of 0.119, showing its significant influence on scheduling decisions. These effect size findings collectively contribute to a detailed comprehension of the varying influences of cultural values on the scheduling of preventive maintenance. This aids in the creation of focused strategies and actions that improve maintenance practices within the organisational environment.

4.3 Result's overview

A correlation has been discovered between the six different cultural value influences and the factors of scheduling for preventive maintenance. Furthermore, the consideration of cultural values revealed the need of scheduling preventative maintenance activities. To ensure the precision of the results, various stages of testing and validation have been conducted. This chapter attempts to clarify the outcomes of the impacts caused by the six cultural value dimensions, along with the identified preferences, on the characteristics of the preventive maintenance schedule aspect.

4.3.1 Identified attributes influences

An analysis of cultural values in the context of scheduling for preventive maintenance demonstrates significant distinctions in the elements that impact decision-making, in comparison to a situation where cultural values are not taken into account. The effect sizes linked to each cultural value component, such as high power distance, masculinity, long-term orientation, collectivism, uncertainty avoidance, and indulgence, indicate the degree to which these values influence the scheduling component. Without taking cultural values into account, decision-making in scheduling preventive maintenance may lack the deeper comprehension offered by cultural considerations. For example, the significant impact of power distance suggests that organisational hierarchies have a crucial influence. Without recognising this cultural factor, our comprehension of decision-making processes would be inadequate. The impact of cultural values on scheduling practices is substantial, highlighting the significance of cultural considerations in optimising preventive maintenance procedures in organisational settings.

4.3.2 Guideline for future research

The results of this study provide an important comprehension of the connection between cultural values and the scheduling for preventive maintenance. As we consider future research initiatives, various paths for investigation become evident. Firstly, additional research may explore the dynamic relationships between cultural values and scheduling practices in various industries and organisational situations, in order to gain a more comprehensive knowledge of how the observed impacts can be applied universally. Furthermore, investigating the temporal dimensions of cultural impacts on the scheduling for preventive maintenance might reveal the structure of these interactions as they change over time. Conducting comparative studies in various cultural contexts would further our comprehension of the significance of cultural values in influencing maintenance techniques. Additionally, doing an analysis of the mediating and moderating factors that could impact the observed associations would enhance our understanding of the fundamental processes involved. In summary, future research should focus on expanding upon these findings and exploring the suggested areas in order to enhance our comprehension of how cultural values and the scheduling of preventative maintenance interact within organisational contexts.

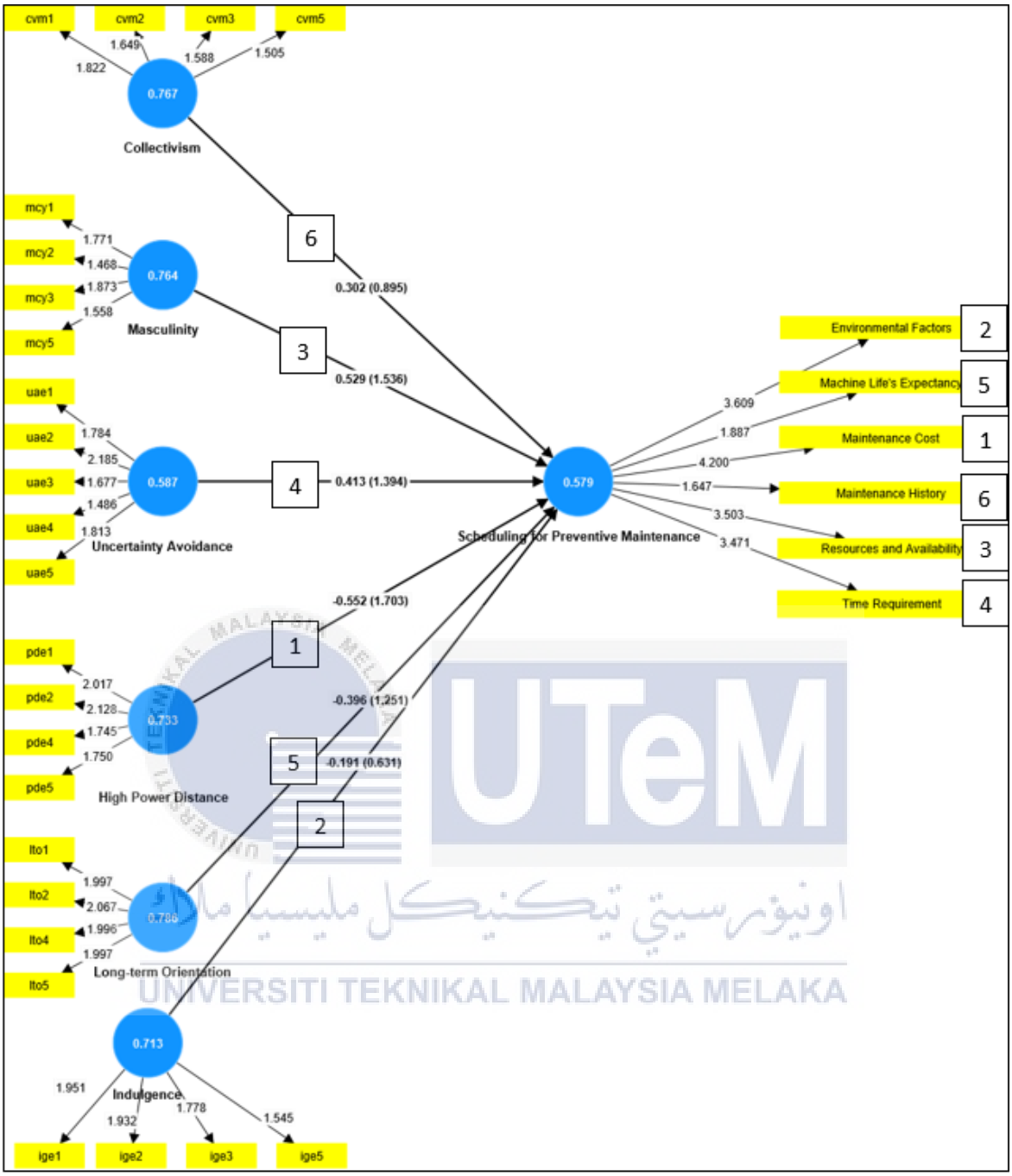

Figure 4.4: Rank of structural model

From the structural model that has been developed shown in Figure 4.4, the value has been ranked from higher into lower based on their influence towards scheduling for preventive maintenance considering cultural influences.

Table 4.7: Rank of cultural preferences

Rank	Description
1	High Power Distance
2	Indulgence
3	Masculinity
4	Uncertainty Avoidance
5	Long-term Orientation
6	Collectivism

Table 4.8: Rank of Factors of Preventive Maintenance

Rank	Description
1	Maintenance cost
2	Environmental Factors
3	Resources and Availibility
4	Time Requirement
5	Machine Life's Expectancy
6	Maintenance History

4.4 Comparative Analysis with "Review of Culture in Maintenance Management of Public Buildings in Developing Countries"

For efficient and sustainable practices in preventive maintenance scheduling, it is crucial to have an in-depth knowledge of the cultural values that shape decision-making. This study focuses on evaluating the scheduling of preventive maintenance, with a specific emphasis on integrating cultural values. In order to enhance comprehension and offer a more comprehensive framework, this study undertakes a comparison analysis with "Review of Culture in Maintenance Management of Public Buildings in Developing Countries". Through comparing findings with those of the chosen case study, the goal is to identify similarities, differences, and practical consequences that enhance the development of preventive maintenance procedures. This comparison investigation not only deepens

this study but also aims to reveal significant insights that may be applied to real-world situations. This aim to explore the complex relationship between cultural values and the scheduling of preventative maintenance.

From the study “Review of Culture in Maintenance Management of Public Buildings in Developing Countries”, the impact of culture on stakeholder behaviour and its subsequent effect on successful upkeep in public infrastructure maintenance is evident in the larger debate. The abstracted study emphasises that culture is crucial in attaining national development objectives and preserving public infrastructure, while expressing concern about the potential negative outcomes resulting from a lack of cultural compliance among stakeholders. The present research, named "The Assessment of Scheduling for Preventive Maintenance Considering Cultural Value" in Malaysia, expands on these observations to examine how cultural values specifically influence the difficulties and possibilities of scheduling preventive maintenance in the Malaysian setting. Our research, in line with the conclusions of the summarised study, contributes a new aspect which are behavioural change. Into the discussion, providing strategic insights for effectively managing current and planned public structures in Malaysia. In the following sections, we will explore the methodology, findings, and consequences. Our objective is to present a comprehensive and culturally relevant framework that supports the long-term sustainability of maintenance methods, specifically in the setting of Malaysia.

4.4.1 Methodology and Cultural Value Integration

The method of inquiry utilised in this study is a systematic review with the objective of analysing maintenance management (MM) frameworks from developed countries. The objective is for identifying any deficiencies that may fail to consider the distinct cultural circumstances of developing nations. The primary emphasis is on the behavioural component of MM, which encompasses the examination of maintenance culture in conjunction with other previously investigated components.

The literature study consists of two stages: firstly, the identification of seven reputable academic databases renowned for their comprehensive coverage of peer-reviewed journals in the construction sector, and secondly, conducting a literature search using precise keywords pertaining to maintenance management and cultural elements. The search is restricted to articles written in English.

At first, a total of 420 articles were detected. However, after further analysis, 301 patents and irrelevant articles were excluded. There are 117 articles that are specifically relevant to the topic and need to be analysed further. The systematic review emphasises the significant impact of culture on MM, specifically how it affects the actions of maintenance professionals and users of public buildings and assets.

The study's scope is limited to the selected databases since they contain a wide range of relevant publications. Furthermore, the research primarily concentrates on public buildings, offering a detailed comprehension of maintenance culture within the wider framework of public infrastructure. The study methodology indicated in Figure 4.5 provides

a dependable framework for conducting a systematic review and analysis of literature pertaining to the cultural dimensions of maintenance management in public buildings.

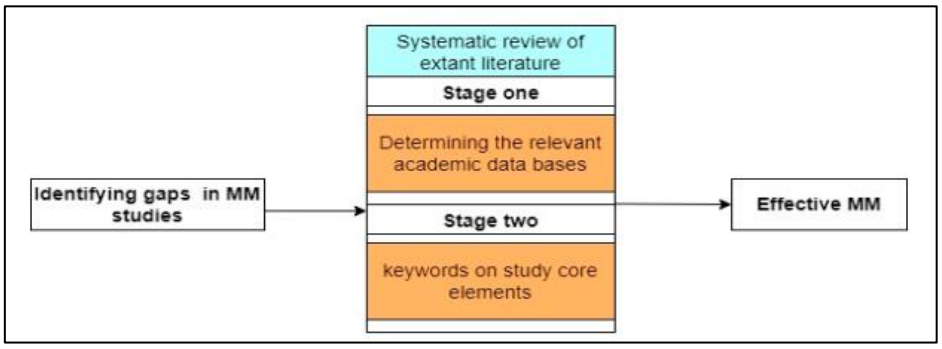

Figure 4.5: Research methodology adopted for the systematic review from Review of Culture in Maintenance Management of Public Buildings in Developing Countries (2022)

4.4.2 Key Findings on Scheduling for Preventive Maintenance

The results on the scheduling of preventative maintenance highlight the crucial role it holds in the management of maintenance for public buildings in emerging nations. The literature review in the study did not specifically address scheduling-related findings. However, it highlighted the crucial significance of maintenance culture and behavioural change in improving the maintenance process and effectively managing public buildings.

The study proposes the establishment of a standard for the maintenance process, the implementation of an early warning system to detect broken components, and the use of high-quality replacement materials for the ongoing maintenance of public buildings. These proposals propose a comprehensive strategy for maintenance management, highlighting the importance of proactive planning and scheduling to guarantee the durability and effectiveness of public infrastructure.

Furthermore, the research reveals that effective change management, stakeholder engagement, and comprehension of their requirements are vital components in developing maintenance management policies. These factors not only enhance the overall performance of the maintenance process but also indicate that it is crucial to incorporate a culture shift towards proactive maintenance planning and scheduling. Implementing this approach allows public buildings in developing nations to gain advantages from enhanced maintenance strategies that proactively tackle potential problems before they worsen, so fostering sustainability and resilience in infrastructure administration.

4.4.3 Implications and Practical Applications

The case study's results have significant implications and practical applications for maintenance managers and policymakers in developing nations. They provide actionable insights to improve the maintenance management of public buildings. These findings provide a significant resource for comprehending the importance of maintenance culture and behavioural modification in attaining efficient maintenance practices.

Maintenance managers can utilise the findings to establish new areas of maintenance emphasis, specifically in fostering behavioural modification, which is crucial for effectively maintaining both current public buildings and future proposed structures. The study emphasises the importance of motivating stakeholders involved in the maintenance process and meeting their requirements in order to enhance their behaviour towards maintenance operations.

Another practical application is the development of maintenance instruments and policies, with a particular focus on taking into account the behaviour of stakeholders and the cultural environment of developing nations. This approach recognises that successful maintenance plans must be in accordance with the attitudes, behaviours, and cultural subtleties unique to the respective locations.

Furthermore, the study promotes the need for continued research to implement the theoretical stances and discoveries in practical scenarios. This guarantees that maintenance management policies and concepts are customised to the particular cultural environment of emerging nations, promoting flexibility and durability.

The study identifies various factors that have an impact on maintenance culture, emphasising the significance of effective communication, reward systems, recognition, empowerment, motivation, involvement, strategy and work planning, teamwork, good policy systems, training and education, and organisational cultures. The role of stakeholders is a significant factor in influencing maintenance culture, highlighting the importance of addressing the attitudes and behaviours of persons participating in the maintenance process.

Moreover, the cultural background of a country or region is acknowledged as a substantial factor that affects maintenance culture. Different cultures exhibit diverse attitudes towards maintenance and building management. The existence of a robust maintenance culture is recognised as a factor that contributes to the efficient administration of public buildings, but the absence of such a culture can result in the abandonment and decay of these facilities. The study proposes that by providing motivation to maintenance people, addressing their needs, and acknowledging their efforts, there can be a significant enhancement in their behaviour towards the maintenance process and the buildings under

their care. The significance of cultural factors and including relevant parties in the creation of efficient maintenance plans for public infrastructure in emerging nations is emphasised by these practical consequences.

4.4.4 Conclusion From This Finding

Ultimately, the analysis of the research conducted in the mentioned studies, particularly those examining maintenance culture and associated elements, provides significant knowledge for improving maintenance methods in public buildings, specifically in developing nations. The acknowledgment of the significant influence of cultural values, as determined by Hofstede's six dimensions, is closely connected to crucial considerations in the planning of preventive maintenance.

The aspects that are emphasised for the scheduling of preventive maintenance, which include maintenance cost, environmental considerations, machine life expectancy, resource availability, maintenance history, and time requirements, collectively emphasise the complex nature of maintenance management. These aspects are deeply intertwined in the cultural fabric, exerting influence on the decisions, behaviours, and attitudes of stakeholders engaged in the maintenance process.

The case study highlights the need of maintenance managers and policymakers taking cultural values into account when implementing scheduling techniques. The focus on maintenance culture and behavioural change is in accordance with the cultural dimensions outlined by Hofstede, which offers a structure for comprehending and dealing with the complexities of cultural influences.

When considering "The Assessment of Scheduling for Preventive Maintenance Considering Cultural Values," it is crucial to prioritise the inclusion of cultural values, as described by Hofstede's dimensions, in the development of scheduling strategies for preventive maintenance. This has significant consequences for the overall effectiveness of such methods. In order to achieve effective implementation and stakeholder participation, it is necessary to evaluate the aspects found in my study, such as maintenance cost, environmental considerations, machine life expectancy, resource availability, maintenance history, and time needs, within the cultural framework.

The practical implications of acknowledging and incorporating cultural norms go beyond the specific context of the case study, highlighting the importance of a comprehensive and culturally sensitive approach when planning for preventative maintenance. My study alignment of maintenance tactics with cultural values contributes to the broader discussion on sustainable and culturally adaptable maintenance practices. This paves the way for easier and efficient infrastructure management in developing nations.

4.5 Summary

This study examines the impact of cultural values on the scheduling of preventive maintenance in the industrial sector. Information was gathered from a total of 36 individuals employed by two manufacturing companies through the utilisation of Google Forms. The study employed SmartPLS to do structural equation modelling (SEM) and utilised Partial Least Squares (PLS) for descriptive analysis. Hierarchical Cluster Analysis (HCM) was employed to ascertain the associations between aspects of scheduling for preventive maintenance and cultural values. The results indicate that cultural values, including collectivism, individuality, masculinity, uncertainty avoidance, power distance, long-term orientation, and indulgence versus restraint, have a substantial impact on the scheduling process. The study emphasises the difficulties encountered when implementing alterations in preventative maintenance scheduling systems and the strategies adopted to address them. The study also investigates the correlation between cultural values and scheduling habits, demonstrating that high power distance, masculinity, long-term orientation, collectivism, uncertainty avoidance, and indulgence exert substantial influences on scheduling decisions. The findings offer valuable insights into the intricate correlation between cultural values and scheduling habits, which can assist in formulating ways to enhance preventative maintenance practices in organisational settings.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The research conducted in "The Assessment of Scheduling for Preventive Maintenance Considering Cultural Values" produced important insights regarding the relationship between scheduling decisions in preventive maintenance and cultural values. The study had three primary goals which are firstly, to identify the criteria of scheduling preventive maintenance in literature. Secondly, to determine the significant relationship between cultural values and the assessment of scheduling preventive maintenance in Malaysia. Thirdly, to evaluate the relationship between cultural values and scheduling preventive maintenance in Malaysia.

The identification of factors that influence the scheduling of preventive maintenance, such as maintenance cost, environmental factors, machine's life expectancy, resources and availability, maintenance history and time requirement, establishes a comprehensive basis for understanding the complex decision-making involved in maintenance management. This knowledge is essential for professionals and policymakers in developing efficient policies that tackle many and linked factors.

The research also effectively explored the correlation between cultural values and the evaluation of preventive maintenance scheduling in Malaysia. The study emphasised the importance of cultural effects on decision-making processes by utilising Hofstede's cultural dimensions. The results revealed a significant correlation between cultural values and the assessment of scheduling methods, highlighting the importance of adopting a culturally

aware strategy in the field of maintenance management. The criteria and cultural factors highlighted in this study offer a strong basis for future research and practical applications. They can help organisations develop more successful and culturally appropriate preventative maintenance methods.

5.2 Recommendations

To guide future research on "The Assessment of Scheduling for Preventive Maintenance," it is crucial to prioritise the collection of accurate and contextually appropriate data from the maintenance department in the manufacturing industry. The effectiveness of preventive maintenance techniques depends on the considerate choices made in the maintenance field, including scheduling procedures, resource allocation, and operational factors. In order to enhance the precision and relevance of research results, it is crucial to build a cooperative and involved cooperation with key stakeholders in the maintenance teams. This method enables a thorough exploration of the practical complexities of preventive maintenance, providing useful insights that may not be evident when using a more broad perspective. Researchers can acquire firsthand knowledge, empirical experiences, and insights into the dynamic elements that influence scheduling decisions by fostering a solid connection with the maintenance department. By adopting an analytical approach, one can not only enhance their comprehension of preventative maintenance but also effectively pinpoint industry-specific obstacles and prospects. The dedication to collecting data directly from the maintenance department is crucial for creating a thorough account of scheduling methods, which allows for the development of specific and effective recommendations.

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APPENDICES

APPENDIX A: GANTT CHART

No.	Project Activities	Plan VS Actual Plan	October			November				December				January			
		Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	PSM Briefing	Plan															
		Actual															
2.	Report Briefing with Supervisor	Plan															
		Actual															
3.	Report writing: Chapter 1 (Introduction)	Plan															
		Actual															
4.	Report writing: Chapter 2 (Literature Review)	Plan															
		Actual															
5.	Report writing: Chapter 3 (Methodology)	Plan															
		Actual															
6.	Report writing: Chapter 4 (Preliminary Results)	Plan															
		Actual															
7.	Report Finalization	Plan															
		Actual															
8.	Report Submission	Plan															
		Actual															
9.	Slide Preparation	Plan															
		Actual															
10.	Final Improvement	Plan															
		Actual															
11.	Final Presentation	Plan															
		Actual															

APPENDIX B

APPENDIX B: QUESTIONNAIRE

A STUDY ON:

THE ASSESSMENT OF SCHEDULING FOR PREVENTIVE MAINTENANCE CONSIDERING CULTURAL VALUE

5 Minutes Survey

Dear Respondents,

I am Syahira Binti A. Kadir, a final year student at Universiti Teknikal Malaysia Melaka (UTeM) who is now enrolled in the bachelor's degree project under the Fakulti Teknologi dan Kejuruteraan Industri dan Pembuatan (FTKIP). I am conducting a study on "The Assessment of Scheduling for Preventive Maintenance Considering Cultural Value". Your replies will be kept confidential and used just for the purpose of this study.

I appreciate for your precious time in responding to the questionnaire.

Sincerely,

Syahira Binti A. Kadir,
Student UTeM.

Dr. Ihwan Ghazali,
Supervisor

PART A (RESPONDENTS)

BACKGROUND

To respond to each question, please write a 'V' in the corresponding box.

1. Your age (years)
   - ☐ 16 - 24
   - ☐ 25 - 34
   - ☐ 35 - 44
   - ☐ 45 - 54
   - ☐ 55 - 64
   - ☐ 65 - over

2. What is your gender?
   - ☐ Male
   - ☐ Female

3. What is your marital status?
   - ☐ Single
   - ☐ Married

4. Academic qualification
   - ☐ Diploma
   - ☐ Degree
   - ☐ Master
   - ☐ PhD
   - ☐ Others

5. Your income per month?
   - ☐ Less than RM1000
   - ☐ RM1001 – RM2000
   - ☐ RM2001 – RM 3000
   - ☐ RM3001 – RM 4000
   - ☐ RM4001 – RM5000
   - ☐ More than RM5001

PART B (CULTURAL VALUES)

In this part, you will be asked about several aspects relating to "Cultural value". Please state how much you agree to each of the statements of "Cultural value" by placing a tick (√) in the appropriate box. The number will be on a scale from 1 to 7, where 1 means 'strongly disagree' whereas 7 indicates 'strongly agree'. The cultural values will focus on:

Culture	Explanation
Collectivism	To be a member of the group is more important than being an individual.
Masculinity	Achievement or targeted purpose rather than style, fashion (femininity).
Uncertainty avoidance	Feeling threatened and trying to avoid threats.
Power Distance	The consequences of power inequality and authority relations in society
Long-term orientation	Focusing on the future, having perseverance and being thrifty.
Indulgence	An environment that lets people enjoy themselves and have fun without much trouble.

How to answer (example):

1.	Cultural value can influence the customer preferences.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

To express your level of agreement or disagreement with the following assertions, please tick the box (√) that best describes your opinion.

Collectivism

1.	People should put the group they are a part of ahead of their own needs.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

2.	Even when things are hard, people should stick with the group.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

3.	The group's well-being is more important than individual gains.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

4.	The success of the group is more important than the success of any one person.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

5.	People should be told to stick with the group even if it means giving up their own goals.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

Masculinity

1.	Having a successful career is more crucial for males than it is for women.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

2.	Men are more likely to use logic and reason to find solutions, while women are more likely to rely on their emotion.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

3.	Men typically use an aggressive, violent approach to solving difficult situations.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

4.	A guy can always perform some tasks better than a woman.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

5.	In our society, being strong and tough are seen as good qualities.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

Uncertainty avoidance

1.	I need instructions that are very clear and specific so I always know what to do.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

2.	It is important to follow directions and steps very carefully.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

3.	Standardized ways of doing things at work are helpful.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

4.	Rules and regulations are significant because they let me know what is required of me.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

5.	It is important to have instructions for tasks.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

Power Distance

1.	Most decisions should be made by those in higher positions without involving those in lower positions.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

2.	The opinions of those in lower positions shouldn't be asked too frequently by those in higher positions.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

3.	Social connections with those in lower positions should be avoided by those in higher positions..								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

4.	People in high position shouldn't give important jobs to people in lower position.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

5.	People in lower positions shouldn't argue with what people in higher positions decide.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

Long-term orientation

1.	Taking good care of financial management								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

2.	Persistence is the quality of continuing despite obstacles.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

3.	Stagnation and stability of the self.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

4.	Long-term planning.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

5.	Putting up a lot of effort to achieve success in the future.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

Indulgence

1.	I often treat myself with enjoyable things, even if they are not required.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

2.	I believe it is important to reward myself for my hard work and achievements.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

3.	I believe in enjoying the present moment rather than worrying too much about the future.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

4.	I believe that life is too short to deny oneself simple pleasures and comforts.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

5.	I think it's important to put my own fun and happiness first, even if that means going against what society says I should do.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

PART C (FACTORS OF SCHEDULING FOR PREVENTIVE MAINTENANCE)

In this part, you will be asked about several "Factor of scheduling for preventive maintenance". Please state how much you agree on the statement of “Factor of scheduling for preventive maintenance” by placing a mark (√) in the appropriate box. The number will be on a scale from 1 to 7, where 1 means ‘strongly disagree’ whereas 7 indicates ‘strongly agree’. The factors of scheduling for preventive maintenance will focus on:

Factors of scheduling for preventive maintenance	Explanation
Maintenance Cost	Maintenance cost encompasses the overall expenses that an organisation bears in order to uphold, mend, and ensure the operational efficiency and durability of its physical assets, facilities, or equipment.
Environmental Factors	Environmental variables refer to every aspect of the surroundings, conditions, and elements, including weather, landscape, and ecosystems, that impact organisms, ecosystems, and human activities inside a certain region.
Machine’s Life Expectancy	Machine's life expectancy is the time frame or predicted lifespan during which a machine or equipment is expected to operate effectively before needing expensive repairs, replacements, or becoming outdated.
Resources and Availability	The presence and accessibility of materials, tools, or assets required for an operation or project at a given time or location can be referred as the resources and availability.
Maintenance History	The maintenance history of a specific asset or machine contains all previous actions, repairs, and upkeep activities, providing a record of its maintenance and performance throughout time.
Time Requirement	The time requirement provides the duration or amount of time required to perform a task, activity, or process, showing the time limit required for its successful execution.

Maintenance Cost

1.	The existing preventative maintenance routine efficiently reduces unwanted costs for repairs.							
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

2.	Performing scheduled preventive maintenance tasks has an obvious beneficial effect on decreasing total maintenance costs.							
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

3.	The specified budget for preventative maintenance appears to be reasonable, given the cost savings it offers by preventing significant breakdowns.							
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

4.	Maintenance expenses could be reduced greatly by optimizing our preventive maintenance schedule.							
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

5.	Reductions in repair costs serve as clear evidence of the return on investment generated by the routine preventive maintenance operations.							
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

Environmental Factors

1.	Severe temperatures or humidity have a significant effect on the level of preventive maintenance needed for equipment.							
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

2.	Exposure to environmental variables such as salt and chemicals significantly increases the risk of corrosion and damage to machinery, which requires more frequent maintenance checks.							
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

3.	Elevated levels of dust or pollution in our working environment amplify the frequency of maintenance necessary for our equipment.							
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

4.	The preventive maintenance schedule we employ takes into consideration the possibility that equipment functionality may be negatively impacted by natural disasters or extreme weather events.

	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

5.	The ongoing surveillance of environmental conditions is critical in order to optimise the schedule for preventive maintenance and minimise equipment failures.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

Machine's Life Expectancy

1.	Commitment to regular preventive maintenance helps to the machine's maintained optimal performance over its entire lifespan.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

2.	Proper preventive maintenance conserves the wear and strain on our machinery, extending its operating life.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

3.	Predictive maintenance solutions extend the overall lifespan of equipment significantly.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

4.	Neglecting of carrying out preventive maintenance frequently significantly reduces the estimated lifespan of machinery.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

5.	Applying technological advances with our preventive maintenance method improves machine lifespan.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

Resources and Availability

1.	Skilled staff necessary to perform preventive maintenance are always accessible when needed.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

2.	Maintenance tools and equipment are easily accessible and quickly available for scheduled maintenance work.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

3.	We have regular access to essential replacement parts for maintenance, minimising downtime due to unavailability.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

4.	Throughout the year, resource availability stays consistent, ensuring that preventative maintenance routines are not disrupted.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

5.	The availability of resources is directly linked to the success and utility of our preventative maintenance initiatives.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

Maintenance History

1.	Previous preventative maintenance schedules have been shown to be effective in reducing unexpected breakdowns.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

2.	Historical maintenance events played a role in the improvement of the present preventive maintenance strategy.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

3.	Previous maintenance failures or breakdowns have given significant knowledge into improving existing preventive maintenance routines.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

4.	Past projections regarding maintenance requirements have been mostly correct, assisting in the development of future preventive maintenance plans.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

5.	The analysis gained from our past maintenance records is reliable and useful in designing our present preventative maintenance programmes.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

Time Requirement

1.	The amount of time needed to accomplish the activities must be carefully considered when scheduling preventative maintenance.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

2.	The time given for preventative maintenance tasks is sufficient to cover the needs for thorough equipment examinations and repair.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

3.	Our preventive maintenance initiatives allows for flexible time allocation, allowing us to accommodate unanticipated repair needs without causing severe interruptions.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

4.	Preventive maintenance time that is properly allocated lowers overall equipment downtime due to unforeseen malfunctions.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

5.	Preventive maintenance performed on time provides straightforward operational continuity with no unexpected interruptions.								
	Strongly disagree	□1	□2	□3	□4	□5	□6	□7	Strongly agree

End of Questionnaire
We appreciate your time and effort in helping us with this study.